

ADDENDUM NO. 3 ISSUED BY

ABHA Architects, Inc.  
1621 N. Lincoln Street  
Wilmington, Delaware 19806

NOTICE: Attach this Addendum to the Project Manual for this project. It modifies and becomes a part of the Contract documents. Work or materials not specifically mentioned herein are to be as described in the main body of the Specifications and as shown on the Drawings.

Acknowledge receipt of the Addendum in the space provided on the Bid Form. This Addendum is being transmitted to contractors who have received Contract Documents. If there are any problems with legibility or content, please contact ABHA Architects, Inc. (302) 658-6426.

ATTACHMENTS

Pre-Bid Sign-in Sheet

Specifications:

Section 08 1113	HOLLOW METAL DOORS AND FRAMES
Section 08 8000	GLAZING
Section 09 5100	ACOUSTICAL CEILINGS
Section 10 2310	GLAZED INTERIOR WALL AND DOOR ASSEMBLIES
Section 12 2413	WINDOW TREATMENTS – ROLLER SHADES
Section 23 0600	AIR DISTRIBUTION & ACCESS
Section 23 0760	AH EQUIPMENT
Section 23 0900	ATC
Section 23 0450	REFRIGERATION EQUIPMENT

Drawings:

Architectural:	A-405, A-406, A-601
Plumbing:	P-700, P-701
Mechanical:	M-700, M-701, M-702, M-703, M-704, M-705
Electrical:	E-103.1, E-113.1, E-601, E-700, E-701, E-702, E-703, E-704, E-705

RFI CLARIFICATIONS:

1. Scaffolding:
  - a. Contractor shall provide and maintain scaffolding Abatement Contractors work.
  - b. Scaffolding is required throughout the auditorium and the front portion of stage with the deck approximately 6 feet from the existing ceiling.
  - c. Provide metal decking with 3/4 inch plywood overlay. Abatement Contractor shall cover the plywood with multiple layers of 6 mil poly sheeting to keep the plywood free of contamination.

- d. Provide two points of access about 4'x4' wide with railings. (one point of access should be at the exit door on the west side of the stage to aid in the removal of waste).
  - e. Estimated time of use for abatement is 6-8 weeks. Platforms shall be designed to support a 10-person crew.
  - f. Abatement Contractor shall provide waiver of liability for their workers to the General Construction Contractor.
  - g. Abatement Contractor:     ASTEC Environmental Services  
  1554 Lorewood Grove Road  
  Middletown, DE 19709  
  (302)378-2717  
  Attn: Matt Elbourn
  - h. Scaffolding Construction to begin; Monday, June 10.
2. Auditorium Roof Deck Heights:
- a. Stage: Roof Deck is approximately 26'-5" above stage.
  - b. Auditorium: Roof Deck Varies; exist deck slopes. Auditorium floor slopes. Approximate 24'-0" +/- above first floor elevation.

CHANGES TO PROJECT MANUAL:

1. Modify Sections:
- a. Section 00 9500 GENERAL AND SPECIAL INSTRUCTION FOR STATE OF DELAWARE AND SCHOOL DISTRICT
    - i. Delete Paragraph 1.13
  - b. Section 23 0210, "BASIC MATERIALS AND METHODS – HVAC"
    - i. Page 23 0210-1, Paragraph 1.2.A: DELETE 9 & 10.
    - ii. Page 23 0210-3, Paragraph 2.8: DELETE in its entirety.
    - iii. Page 23 0210-5, Paragraph 3.1.R: DELETE in its entirety.
  - c. Section 23 0215, "VALVES"
    - i. Page 23 0215-1, Paragraph 1.2.A: DELETE 4.
  - d. Section 23 0230, "Insulation & Covering – HVAC"
    - i. Page 23 0230-1, Paragraph 1.2.B: DELETE 4.
  - e. Section 23 0450, "REFRIGERATION EQUIPMENT – HVAC"
    - i. ADD new section. See attached Section 23 0450.

- f. Section 23 0600, "AIR DISTRIBUTION & ACCESSORIES – HVAC" See attached revised Section 23 0600.
    - i. Page 23 0600-1, Paragraph 1.2.A:
      - ADD "10. Flexible Air Duct"
      - ADD "11. VAV Units with Reheat."
    - ii. Page 23 0600-8, Paragraph 2.9.F:
      - ADD Pottorff as Manufacturer.
    - iii. Page 23 0600-8: ADD Paragraphs 2.10 & 2.11.
  - g. Section 23 0605, "FANS"
    - i. Page 23 0605-1, Paragraph 1.2.A: DELETE 1 and 3 and renumber accordingly.
    - ii. Page 23 0605-2, Paragraph 2.1: DELETE in its entirety.
    - iii. Page 23 0605-2, Paragraph 2.3: DELETE in its entirety.
  - h. Section 23 0760, "AIR HANDLING EQUIPMENT".
    - i. REVISE Section. See attached revised Section 23 0760.
  - i. Section 23 0900, "AUTOMATIC TEMPERATURE CONTROL"
    - i. Page 23 0900-2, Paragraph 1.6.A: REVISE manufacturers. See attached revised Section 23 0900.
    - ii. Page 23 0900-5: ADD Section 2.8, "SEQUENCE OF OPERATIONS". See attached revised Section 23 0900.
2. Remove Sections: N/A
3. Revised/replaced Sections: (see attached)
- a. Section 12 2413 WINDOW TREATMENTS – ROLLER SHADES
  - b. Section 23 0600 AIR DISTRIBUTION & ACCESS
  - c. Section 23 0760 AH EQUIPMENT
  - d. Section 23 0900 ATC
4. Added Sections: (see attached)
- a. Section 08 1113 HOLLOW METAL DOORS AND FRAMES
  - b. Section 08 8000 GLAZING
  - c. Section 09 5100 ACOUSTICAL CEILINGS
  - d. Section 10 2310 GLAZED INTERIOR WALL AND DOOR ASSEMBLIES
  - e. Section 23 0450 REFRIGERATION EQUIPMENT

CHANGES TO DRAWINGS:

1. Drawing Replaced with Changes:

- a. Architectural: A-405, A-406, A-601
- b. Electrical: E-103.1, E-113.1

2. New Drawings/Sketches Added:

- a. Plumbing: P-700, P-701
- b. Mechanical: M-700, M-701, M-702, M-703, M-704, M-705
- c. Electrical: E-700, E-701, E-702, E-703, E-704, E-705

3. Changes to Drawings:

a. ARCHITECTURAL:

i. Drawing A-102.3.

- DEMOLITION KEYNOTES 35 add the following:
  - “- BY THE FURNITURE CONTRACTOR.”
- DEMOLITION KEYNOTES 36 add the following:
  - “- BY THE FURNITURE CONTRACTOR.”
- DEMOLITION KEYNOTES 37 add the following:
  - “- BY THE FURNITURE CONTRACTOR.”
- DEMOLITION KEYNOTES 38 add the following:
  - “- BY THE GENERAL CONTRACTOR.”
- DEMOLITION KEYNOTES 40 add the following:
  - “- BY THE GENERAL CONTRACTOR.”
- ADD KEYNOTE 40 TO PERIODICAL STORAGE ROOM

ii. Replace drawings with attached

- A-405
- A-406
- A-601

b. PLUMBING

iii. Drawing P-101.1 “DEMOLITION FIRST FLOOR PLANS AREA A PLUMBING”. Refer to attached Sketch P-700.

- ADD existing 4” storm drain riser to:
  - Plan A1 “DEMOLITION – BELOW SLAB – FIRST FLOOR – AREA A”.
  - Plan A4 “DEMOLITION – ABOVE SLAB – FIRST FLOOR – AREA A” (in future Electric Room A112).

iv. Drawing P-111.1 "NEW CONSTRUCTION FIRST FLOOR PLANS AREA A PLUMBING". Refer to attached Sketch P-701

- ADD existing 4" storm drain riser and condensate drainage for HVAC HP/2 Unit to
  - Plan A1 "NEW CONSTRUCTION – BELOW SLAB – FIRST FLOOR – AREA A".
  - Plan A4 "NEW CONSTRUCTION – ABOVE SLAB – FIRST FLOOR – AREA A" for Electric Room A112.

f. MECHANICAL

i. Drawing M-101.1, "DEMOLITION FIRST FLOOR AREA A, B, & C MECHANICAL

- ADD "M4 Demolition – Platform 102A – Area A". Refer to attached Sketch M-700.

ii. Drawing M-103.1, "DEMOLITION ROOF PLAN AREA A MECHANICAL"

- CHANGE demo note tag on gooseneck exhaust from 10 to 25. Refer to attached Sketch M-701.
- ADD Note 25. Refer to attached Sketch M-701.

iii. Drawing M-111.1, "NEW CONSTRUCTION FIRST FLOOR AREA A, B, & C MECHANICAL"

- PROVIDE locations for thermostats serving new RTU-1. Refer to attached Sketch M-702.
- CHANGE RA grille from one (1) continuous 28x192 to four (4) stacked 28x48 RA grilles. Refer to attached Sketch M-702.
- REMOVE piping called out as "2 ½" HWS'R UP TO RE-HEAT COILS IN NEW RTU-1 ON ROOF". Refer to attached Sketch M-702.
- ADD HP-2 in Elec A112. Refer to attached Sketch M-702.

iv. Drawing M-112.1, "NEW CONSTRUCTION SECOND FLOOR AREA A MECHANICAL". Refer to attached revised Drawing M-112.1.

- REVISE Auditorium SA duct layout.
- ADD duct smoke detectors to SA and RA ducts from AHU-1, AHU-2, and AHU-3.
- ADD relief air duct and MOD on RA duct of AHU-1, AHU-2, and AHU-3.

- v. Drawing M-112.3, "NEW CONSTRUCTION SECOND FLOOR AREA C MECHANICAL"
  - SHOW new thermostat local serving VAV-2-2. Refer to attached Sketch M-703.
- vi. Drawing M-113.1, "NEW CONSTRUCTION ROOF PLAN AREA A MECHANICAL"
  - REVISE SA duct entering Auditorium ceiling space. Refer to attached Sketch M-704.
  - ADD duct smoke detectors to SA main and RA main from RTU-1. Refer to attached Sketch M-704.
  - ADD ACC-2 to serve HP-2 in Elec A112. Refer to attached Sketch M-704.
- vii. Drawing M-502, "DETAILS MECHANICAL"
  - ADD VAV Reheat Coil Detail. Refer to attached Sketch M-705.
- viii. Drawing M-601, "SCHEDULES MECHANICAL". Refer to attached revised Drawing M-601.
  - REVISE SAU-3 size in SOUND ATTENUATING UNIT SCHEDULE.
  - REVISE notes on AIR HANDLING UNIT SCHEDULE.
  - REVISE notes on ROOFTOP AIR HANDLING UNIT SCHEDULE.
  - ADD HP-2 and ACC-2 to SPLIT SYSTEM HEAT PUMP SCHEDULE.
- g. ELECTRICAL
  - i. Drawing E-101.1, DEMOLITION FIRST FLOOR AREA A - ELECTRICAL:
    - ADD demolition for EF-18. Refer to attached Sketch E-700.
  - ii. Drawing E-102.3, DEMOLITION SECOND FLOOR AREA C - ELECTRICAL:
    - REMOVE demolition scope from Lan C200D and Media Work Room C200B. Refer to attached Sketch E-701.
  - iii. Drawing E-103.1, DEMOLITION ROOF PLAN AREA A - ELECTRICAL:
    - ADD new mechanical equipment and tags to plan. Refer to attached revised Drawing E-103.1.
    - ADD general sheet note. Refer to attached revised Drawing E-103.1.

- iv. Drawing E-103.2, DEMOLITION ROOF PLAN AREA A - ELECTRICAL:
  - DELETE drawing in its entirety.
- v. Drawing E-103.3, DEMOLITION ROOF PLAN AREA A - ELECTRICAL:
  - DELETE drawing in its entirety.
- vi. Drawing E-103.4, DEMOLITION ROOF PLAN AREA A - ELECTRICAL:
  - DELETE drawing in its entirety.
- vii. Drawing E-111.1, NEW FIRST FLOOR AREA A - ELECTRICAL:
  - ADD fire alarm relay module and monitor module for stage curtain. Refer to attached Sketch E-702.
  - ADD fire alarm relay module and monitor module to legend. Refer to attached Sketch E-702.
- viii. Drawing E-112.3, NEW FIRST FLOOR AREA C - ELECTRICAL:
  - REMOVE new work in Lan C200D and Media Work Room C200B. Refer to attached Sketch E-703.
- ix. Drawing E-113.1, NEW FIRST FLOOR AREA A - POWER:
  - ADD general receptacles in Auditorium A101. Refer to attached revised Drawing E-113.1.
- x. Drawing E-113.5, NEW FIRST FLOOR AREA E - POWER:
  - ADD note for relocating trash compactor. Refer to attached Sketch E-704.
- xi. Drawing E-114.3, NEW SECOND FLOOR AREA C - POWER:
  - ADD note for power and data mounting direction. Refer to attached Sketch E-705.
- xii. Drawing E-601, SCHEDULE & DETAILS - ELECTRICAL:
  - REVISE Lighting Fixture Schedule. Refer to attached revised Drawing E-601.
  - ADD ACC-1, HP-1, ACC-2 and HP-2 to Mechanical Equipment Electrical Requirements schedule. Refer to attached revised Drawing E-601.
  - ADD and REVISE Mechanical Equipment Electrical Requirements notes. Refer to attached revised Drawing E-601.

**SECTION 08 1113**  
**HOLLOW METAL DOORS AND FRAMES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Thermally insulated hollow metal doors with frames.
- D. Sound-rated hollow metal doors and frames.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 7100 - Door Hardware.
- B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

**1.03 ABBREVIATIONS AND ACRONYMS**

- A. ANSI - American National Standards Institute.
- B. ASCE - American Society of Civil Engineers.
- C. HMMA - Hollow Metal Manufacturers Association.
- D. NAAMM - National Association of Architectural Metal Manufacturers.
- E. NFPA - National Fire Protection Association.
- F. SDI - Steel Door Institute.
- G. UL - Underwriters Laboratories.

**1.04 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- I. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.



- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- M. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- C. Manufacturer's Qualification Statement.

#### 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: [www.steeldoor.org/sdicertified.php](http://www.steeldoor.org/sdicertified.php).
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
  - 1. Ceco Door, an Assa Abloy Group company; \_\_\_\_: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Curries, an Assa Abloy Group company; \_\_\_\_: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 3. Steelcraft, an Allegion brand; \_\_\_\_: [www.allegion.com/#sle](http://www.allegion.com/#sle).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.02 DESIGN CRITERIA

- A. Requirements for Hollow Metal Doors and Frames:
  - 1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
  - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
  - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
  - 4. Door Edge Profile: Manufacturers standard for application indicated.
  - 5. Typical Door Face Sheets: Flush.
  - 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.

7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
  - a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

## 2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Type \_\_\_\_, Exterior Doors: Thermally insulated.
  1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 1 - Standard-duty.
    - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
    - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
  2. Door Core Material: Polystyrene, 1 lbs/cu ft minimum density.
    - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
  3. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene.
  4. Door Thickness: 1-3/4 inch (44.5 mm), nominal.
- C. Type \_\_\_\_, Interior Doors, Non-Fire Rated:
  1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 1 - Standard-duty.
    - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
  2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
  3. Door Thickness: 1-3/4 inch (44.5 mm), nominal.
- D. Type \_\_\_\_, Sound-Rated Interior Doors:
  1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 1 - Standard-duty.
    - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.

- c. Model 1 - Full Flush.
- d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
- 2. Door Core Material: Manufacturer's standard construction as required to meet acoustic requirements indicated.
- 3. Door Thickness: As required to meet acoustic requirements indicated.
- 4. Sound Seals: Refer to Section 08 7100.

#### 2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Frame Profile: Equal rabbet - kerfed unless noted otherwise
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
- E. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

#### 2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

#### 2.06 ACCESSORIES

- A. Glazing: As specified in Section 08 8000, factory installed.
- B. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.
- D. Gasket for kerfed frames.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

#### 3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

#### 3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Install door hardware as specified in Section 08 7100.
- D. Comply with glazing installation requirements of Section 08 8000.

#### 3.04 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

**END OF SECTION**

**SECTION 08 8000**  
**GLAZING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Glass.
- B. Decorative plastic glazing film.
- C. Glazing compounds and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.

**1.03 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- D. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.
- E. GANA (GM) - GANA Glazing Manual; 2008.
- F. GANA (SM) - GANA Sealant Manual; 2008.
- G. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Samples:
  - 1. Glass Units: Submit two samples 12 by 12 inch in size.
  - 2. Decorative Plastic Film: Submit two samples 6 by 6 inch in size.
- D. Certificates: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Certificate: Certify that safety glass meets or exceeds specified requirements.

**1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

**1.06 FIELD CONDITIONS**

- A. Do not install glazing when ambient temperature is less than 50 degrees F (10 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

**1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

- C. Laminated Glass: Provide a five (5) year warranty to include coverage for delamination, including replacement of failed units.

## **PART 2 PRODUCTS**

### **2.01 GLAZING UNITS**

- A. Type G-1 - Single Safety Glazing: Non-fire-rated.
  - 1. Application: All interior glazing unless otherwise indicated.
  - 2. Type: Laminated Safety glass.
  - 3. Tint: Clear.
  - 4. Thickness: 1/4 inch (6 mm).
- B. Type G-1A - Single Safety Glazing: Non-fire-rated.
  - 1. Application: As showing on drawings.
  - 2. Type: Laminated Safety glass.
  - 3. Tint: Clear with obscure laminate coating.
  - 4. Thickness: 1/4".
- C. Type G-1B - Single Safety Glazing: Non-fire-rated.
  - 1. Application: As showing on drawings.
  - 2. Type: Laminated Safety glass.
  - 3. Tint: Clear with removable obscure laminate coating.
  - 4. Thickness: 1/4".
- D. Type G-2 - Single Safety Glazing: Non-fire-rated.
  - 1. Application: Provide this type of glazing in the following locations:
    - a. Glazed interior wall assemblies. Unless otherwise noted.
    - b. Sliding glass doors.
  - 2. Type: Fully tempered float glass as specified.
  - 3. Tint: Clear.
  - 4. Thickness: 1/2 inch (12 mm).
  - 5. Glazing Method: Gasket glazing.
- E. Type G-3 - Single Safety Glazing: Non-fire-rated.
  - 1. Application: Provide this type of glazing in the following locations:
    - a. Glazed interior wall assemblies. As shown on drawings.
  - 2. Types: Fully tempered / laminated safety glass as specified.
    - a. Basis of Design: McGrory Glass, [www.mcgrory.com](http://www.mcgrory.com).
      - 1) 1/4" White BP tempered Low Iron Glass
      - 2) 1/6" Magnetic Backer
      - 3) 1/4" White BP tempered Low Iron Glass
  - 3. Tint: Opaque - White.
  - 4. Glazing Method: Gasket glazing.
- F. Type [G-4] - Single Safety Glazing: Fire-Rated.
  - 1. Application: Provide this type of glazing in the following locations:
    - a. Fire-rated door assemblies
  - 2. Provide products listed by ITS(DIR) or UL(DIR) and approved by authorities having jurisdiction.
  - 3. Safety Glazing Certification: 16cfr 1201
  - 4. Fire Rating Period: 60 mins.

5. Markings for Fire-Resistance-Rated Glazing Assemblies. Provide permanent markings on fire-resistance rated glazing in compliance with ICC (IBC), local building codes, and authorities having jurisdiction.
6.
  - a. Products: SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XLM 60: [www.safti.com/#sle](http://www.safti.com/#sle).
  - b. Substitutions: Refer to Section 01 6000 - Product Requirements.

## 2.02 GLASS MATERIALS

- A. Float Glass Manufacturers:
  1. AGC Flat Glass North America, Inc: [www.na.agc-flatglass.com](http://www.na.agc-flatglass.com).
  2. Guardian Industries Corp: [www.sunguardglass.com](http://www.sunguardglass.com).
  3. Pilkington North America Inc: [www.pilkington.com/na](http://www.pilkington.com/na).
  4. PPG Industries, Inc: [www.ppgideascales.com](http://www.ppgideascales.com).
  5. Substitutions: Refer to Section 01 6000 - Product Requirements.
- B. Float Glass: Provide float glass based glazing unless noted otherwise.
  1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
  2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and Kind FT.
  3. Tinted Types: ASTM C1036, Class 2 - Tinted, color and performance characteristics as indicated.
  4. Thicknesses: As indicated; for exterior glazing comply with requirements indicated for wind load design regardless of thickness indicated.
- C. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
  1. Laminated Safety Glass: Comply with 16 CFR 1201 test requirements for Category II.
  2. Plastic Interlayer:
    - a. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch (0.762 mm) thick, minimum.
    - b. Ionoplast Interlayer: 0.035 inch (0.889 mm) thick, minimum.
  3. Where fully tempered is specified or required, provide glass that has been tempered by the tong-less horizontal method.
  4. Manufacturers:
    - a. AGC Flat Glass North America, Inc: [www.na.agc-flatglass.com](http://www.na.agc-flatglass.com).
    - b. Cardinal Glass Industries: [www.cardinalcorp.com](http://www.cardinalcorp.com).
    - c. Viracon, Architectural Glass segment of Apogee Enterprises, Inc: [www.viracon.com](http://www.viracon.com).
    - d. Substitutions: Refer to Section 01 6000 - Product Requirements.

## 2.03 DECORATIVE PLASTIC FILMS

- A. Manufacturers:
  1. 3M Window Film: [www.3m.com/US/arch\\_construct/scpd/windowfilm](http://www.3m.com/US/arch_construct/scpd/windowfilm).
  2. Substitutions: Refer to Section 01 6000 - Product Requirements.
- B. Product: Fasara Privacy Glazing Film.
  1. Pattern: Fine Crystal Decorative.
  2. Location: Glass Type G-1A & G-1B
  3. Properties:
    - a. General: Plastic finishes field-applied to glass material as visual opaque or decorative film.
    - b. Film: Polyester
    - c. Thickness: 3.2 mils.

- d. Decorative Pattern: Printed.
- e. Adhesive: Acrylic, Pressure Sensitive, Permanent.
- f. Liner: Silicone-coated Polyester.
- g. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84: Class A
  - 1) Flame Spread: 25 maximum.
  - 2) Smoke Developed: 450 maximum.

C.

## 2.04 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) x width of glazing rabbet space minus 1/16 inch (1.5 mm) x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

## 2.05 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing for safety and fire rated glass.

# PART 3 EXECUTION

## 3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

## 3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.

## 3.03 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

- A. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

## 3.04 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

- A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- D. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch (610 mm) intervals, 1/4 inch (6 mm) below sight line.



- E. Fill gaps between pane and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.
- F. Trim protruding tape edge.

### 3.05 INSTALLATION - PLASTIC FILM

- A. Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.
- B. Place without air bubbles, creases or visible distortion.
- C. Fit tight to glass perimeter with razor cut edge.

### 3.06 FIELD QUALITY CONTROL

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

### 3.07 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

### 3.08 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste, \_\_\_\_\_.

**END OF SECTION**

**SECTION 09 5100**  
**ACOUSTICAL CEILINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Suspended metal grid ceiling system.
- B. Acoustical units.
- C. Accessories

**1.02 RELATED REQUIREMENTS**

- A. Division 21: Fire Suppression.
- B. Division 23: Heating, Ventilation, and Air Conditioning.
- C. Division 26: Electrical.
- D. Division 27: Communications.
- E. Division 28: Electronic Safety and Security.

**1.03 REFERENCE STANDARDS**

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.
- D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components, acoustical units, and other related components.
- C. Samples: Submit two samples 12 x 12 inch (305 x 305 mm) or of size illustrating material and finish of acoustical units.
- D. Samples: Submit two samples each, 6 inches (\_\_\_\_ mm) long, of suspension system main runner, cross runner, perimeter molding, and related sections.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Acoustical Units: 100 sq ft (\_\_\_\_ sq m) of each type and size.

**1.06 QUALITY ASSURANCE**

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### 1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

#### 1.08 PROJECT CONDITIONS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Install acoustical units after interior wet work is dry.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels:
  - 1. As listed for each Type..
  - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Suspension Systems:
  - 1. As listed for each Type..
  - 2. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.02 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Panel Type 1:
  - 1. Basis of Design: Subject to compliance with project requirements, the design is based on the following: USG Interiors, LLC, "Glacier Basic".
  - 2. General Locations:
    - a. Corridors
    - b. Classrooms
    - c. Offices
    - d. Library Suite
  - 3. Classification: Provide ceiling panels complying with ASTM E 1264 for type, form and pattern as follows:
    - a. Type: III, mineral base with painted finish
    - b. Form: 4, cast or molded
    - c. Pattern: F, heavy texture
  - 4. Color: Flat White 050.
  - 5. LR: Not less than 0.70.
  - 6. NRC: Not less than 0.65.
  - 7. CAC: Not less than 35.
  - 8. Edge/Joint Detail: FL Flush reveal.
  - 9. Suspension Grid/Width: DX/DXL 15/16 inch.
  - 10. Panel Thickness: 3/4 inch.
  - 11. Modular Size: 24 by 24 inches.
  - 12. VOC Emissions: GreenGuard Gold Certified.
- C. Acoustical Panel Type 2:

1. Basis of Design: Subject to compliance with project requirements, the design is based on the following: Armstrong World Industries, Inc, "Ceramaguard".
2. General Locations:
  - a. Toilet Rooms
3. Classification: Provide ceiling panels complying with ASTM E 1264 for type, form and pattern as follows:
  - a. Type: XX, high density ceramic-like composition with scrubbable finish.
  - b. Pattern: G, Item 605
4. Color: White.
5. LR: Not less than 0.88.
6. NRC: Not less than N/A.
7. CAC: Not less than 40.
8. Edge/Joint Detail: Square Lay-in.
9. Suspension Grid/Width: Prelude Plus XL 15/16 inch.
10. Panel Thickness: 3/4 inch.
11. Modular Size: 24 inches by 24 inches.
12. Humidity / Sag Resistance: HumiGuard.
13. Mold / Mildew Protection: BioBlock
14. VOC Emissions: GreenGuard Gold Certified

D. Acoustical Panel Type 3:

1. Basis of Design: Subject to compliance with project requirements, the design is based on the following: Armstrong World Industries, Inc, "Calla".
2. General Locations:
  - a. Auditorium
3. Classification: Provide ceiling panels complying with ASTM E 1264 for type, form and pattern as follows:
  - a. Type: IV, mineral base with painted finish
  - b. Form: 2
  - c. Pattern: E
4. Color: White.
5. LR: Not less than 0.86.
6. NRC: Not less than 0.85.
7. CAC: Not less than 35.
8. Edge/Joint Detail: Square Tegular. (Notched Square Tegular at Downlight Trim)
9. Suspension Grid/Width: Superfine 9/16 inch.
10. Panel Thickness: 1 inch.
11. Modular Size: 24 by 24 inches.
12. Humidity / Sag Resistance: HumiGuard.
13. Mold / Mildew Protection: BioBlock.
14. VOC Emissions: GreenGuard Gold Certified

2.03 SUSPENSION SYSTEM(S) AND PERIMETER TRIM

A. Suspension System No1: (To be used with Acoustical Panel Type 1)

1. Basis of Design: Subject to compliance with project requirements, the design is based on the following: USG Interiors, LLC, "USG DONN® Brand DX/DXL™ 15/16" Acoustical Suspension System".
2. Structural Classification: heavy duty.
3. Tee Profile: Narrow Face 15/16" wide.

4. Tee Height: 1 1/2".
  5. Grid Module: 2 x 2
  6. Fire Rating: Class A.
  7. Color: standard flat white 050
  8. Accessories:
    - a. Hemmed Angle Molding: 7/8 inch by 7/8 inch.
- B. Suspension System No2: (To be used with Acoustical Panel Type 2)
1. Subject to compliance with project requirements, the design is based on the following:  
Armstrong World Industries, Inc, "Prelude Plus XL".
  2. Structural Classification: heavy duty.
  3. Tee Profile: Narrow Face 15/16" wide.
  4. Tee Height: 1 1/2".
  5. Grid Module: 2 x 2
  6. Fire Rating: Class A.
  7. Color: white
  8. Accessories:
    - a. Hemmed Angle Molding: 7/8 inch by 7/8 inch.
- C. Suspension System No3: (To be used with Acoustical Panel Type 3)
1. Subject to compliance with project requirements, the design is based on the following:  
Armstrong World Industries, Inc, "Prelude Plus XL".
  2. Structural Classification: heavy duty.
  3. Tee Profile: Narrow Face 15/16" wide.
  4. Tee Height: 1 1/2".
  5. Grid Module: 2 x 2
  6. Fire Rating: Class A.
  7. Color: white
  8. Accessories:
    - a. Intersection Downlight Trim:
      - 1) Style: Suprafine
      - 2) Color: White
    - b. Perimeter Edge:
      - 1) Style: AXIOM Knife Edge
      - 2) Size: 6 3/16 inch by 2 1/2 inch.
      - 3) Color White

#### 2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Touch-up Paint: Type and color to match acoustical and grid units.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

#### 3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected ceiling plans.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches (150 mm) of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Use longest practical lengths.
  - 2. Miter corners.
- K. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m). Miter corners accurately and connect securely.
  - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- L. Install light fixture boxes constructed of gypsum board or acoustical panel above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.
- M. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
  - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.

6. Do not attach hangers to steel deck tabs.
  7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches (200 mm) from ends of each member.
- N. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- O. Install special brake-metal shapes at window heads so that they are square and finished to provide a precise fit. Do not use exposed fasteners.

### 3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units with pattern parallel to longest room axis.
- D. Fit border trim neatly against abutting surfaces.
- E. Install units after above-ceiling work is complete.
- F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- G. Cutting Acoustical Units:
  1. Cut to fit irregular grid and perimeter edge trim.
  2. Make field cut edges of same profile as factory edges.
  3. Double cut and field paint exposed reveal edges.
- H. Where round obstructions, bullnose concrete block corners, and other similar conditions occur, provide preformed closures to match perimeter molding.

### 3.04 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

**END OF SECTION**

## **SECTION 10 2310**

### **GLAZED INTERIOR WALL AND DOOR ASSEMBLIES**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Frameless glazed interior wall and door assemblies.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 08 8000 - Glazing.

##### **1.03 REFERENCE STANDARDS**

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's descriptive literature for each component in partition assembly.
- C. Shop Drawings: Drawings showing layout, dimensions, identification of components, and interface with adjacent construction.
  - 1. Include field measurements of openings.
  - 2. Include Elevations Showing:
    - a. Locations and identification of manufacturer-supplied door hardware and fittings.
    - b. Locations and sizes of cut-outs and drilled holes for other door hardware.
  - 3. Include Details Showing:
    - a. Requirements for support and bracing of overhead track.
    - b. Installation details.
    - c. Appearance of manufacturer-supplied door hardware and fittings.
- D. Verification Samples: Two samples, minimum size of 2 inch by 3 inch (51 mm by 76 mm), representing actual material and finish of exposed metal.
- E. Certificates: Contractor to certify that installer of partition assemblies meets specified qualifications.
- F. Operation and Maintenance Data: For manufacturer-supplied operating hardware.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- H. Specimen Warranty.

##### **1.05 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Minimum three years of experience designing, assembling, and installing partition assemblies similar to those specified in this section.

##### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until installation.



## 1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against excessive degradation of metal finishes. Include provision for replacement of units with excessive fading, chalking, or flaking.

## PART 2 PRODUCTS

### 2.01 BASIS OF DESIGN - FRAMELESS GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

- A. Basis of Design: DORMA USA, Inc; Agile 150 Dormotion - Sliding Door System with Cushioning Open/Close Feature : [www.dorma.com/#sle](http://www.dorma.com/#sle).
- B. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 FRAMELESS GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

- A. Frameless Glazed Interior Wall Assembly: Factory fabricated assemblies consisting of full-width and height glass panels fastened with U-channel fittings on top and bottom edge of glass wall.
  - 1. Configuration: As indicated on drawings.
  - 2. U-Channel Fittings: Extruded aluminum, satin anodized finish, dry glazed, and with matching end caps.
    - a. Top channel is 1-1/2 inch (38 mm) high by 1 inch (25.4 mm) deep.
    - b. Bottom channel is 1 inch (25.4 mm) high by 1 inch (25.4 mm) deep.
  - 3. Glass: Section 08 8000 - Glazing.
  - 4. Designed to withstand normal operation without damage, racking, sagging, or deflection.
  - 5. Coordinate wall and door assembly preparation and provide hardware as necessary for fully operable installation.
  - 6. Finished metal surfaces protected with strippable film.
  - 7. Factory assembled to greatest extent practical; may be disassembled to accommodate shipping constraints.
- B. Sliding Glass Doors: Top supported from roller assembly inside compact track with cushioning open/close feature.
  - 1. Door Configuration: Double sliding doors with sidelites on both sides.
  - 2. Track Mount: Ceiling surface-mounted.
  - 3. Track Size: 2-1/2 inch (64 mm) high by 2-13/16 inch (71.4 mm) deep with end caps.
  - 4. Track Finish: Clear anodized.
  - 5. Glass: Section 08 8000 - Glazing.
  - 6. Door Hardware: Pull.
    - a. Style: Back-to-Back Ladder Pull
    - b. Material: Stainless Steel
    - c. Finish: Satin/Brushed
    - d. Height: 49 inch
    - e. Feature: Non-Locking
  - 7. Provide accessories as required for complete installation.

### 2.03 MATERIALS

- A. Glass: Section 08 8000 - Glazing.
- B. Aluminum Components: Conforming to ASTM B221 (ASTM B221M), alloy 6063, T5 temper.

- C. Sealant: One-part silicone sealant, conforming to ASTM C920, clear.

## 2.04 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Color: Clear.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that track supports are properly braced, level within 1/4 inch (6 mm) of required position and parallel to the floor surface.
- C. Verify floor flatness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.
- D. Do not begin installation until supports and adjacent substrates have been properly prepared.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.02 PREPARATION

- A. Clean substrates thoroughly prior to installation.
- B. Prepare substrates using the methods recommended by the manufacturer for achieving acceptable result for the substrate under the project conditions.

### 3.03 INSTALLATION

- A. Install in accordance with glazed interior wall and door assembly manufacturer's instructions.
- B. Fit and align glazed interior wall and door assembly level and plumb.

### 3.04 ADJUSTING

- A. Adjust glazed interior wall and door assembly to operate smoothly from sliding or pivoting positions.

### 3.05 CLEANING

- A. Clean installed work to pristine condition.

### 3.06 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of glazed interior wall and door assembly and identify potential operational problems.

### 3.07 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION**

**SECTION 12 2413**  
**WINDOW TREATMENT – ROLLER SHADES**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Fabric replacement for existing manual roller shades at exterior glazed windows.

**1.02 REFERENCES**

- A. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- B. NFPA 701 - Fire Tests for Flame-Resistant Textiles and Films.

**1.03 SUBMITTALS**

- A. Submit under provisions of Section 013000.
- B. Roller Shade Fabric:
  - 1. Product Data:
    - a. Pattern
    - b. Color
    - c. Anti-Microbial Characteristics
    - d. Fire-Test-Response Characteristics
  - 2. Samples: (2) 6 inch by 6" inch Fabric Sample.
- C. Shop Drawings: Show location and extent of roller shades. Include elevations and dimensions.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who has successfully completed and serviced installations similar in scope to that indicated for this Project.
- B. Source Limitations: Obtain each type of window treatment through one source from a single manufacturer.
- C. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.
- D. Fire-Test-Response Characteristics: Provide window treatment materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Flame-Resistance Ratings: Passes NFPA 701.
- E. Mock-Up: Provide a mock-up (manual shades only) of one roller shade assembly for evaluation of mounting, appearance and accessories.
  - 1. Locate mock-up in window designated by Architect.
  - 2. Do not proceed with remaining work until, mock-up is accepted by Architect.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in window treatment schedule.

**1.06 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install window treatment until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and

humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

#### 1.07 WARRANTY

- A. Installation: One year from substantial completion.

### **PART 2 - PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Approved Manufacturer: This Specification is based on products as indicated under individual product descriptions.

#### 2.02 MANUAL ROLLER SHADES

- A. Basis of specification
  - 1. Basis of Design: MechoShade Systems, Inc.
  - 2. Roller shade assembly: Existing
    - a. MechoShade: MechoShade/5

#### 2.03 ROLLER SHADE FABRIC

- A. Basis of Design: MechoShade Systems, Inc (Match Existing)
  - 1. Window Treatment Fabric:
    - a. EuroTwill Reversible Weave 6000 Series.
    - b. Openess Factor: 3%
    - c. Color: 6010 Nickel
  - 2. Roller shade assembly:
    - a. Apply new shade cloth to existing rollers
  - 3. Direction of Roll: Regular, from back of roller.
  - 4. Bottom Bar: Steel or extruded aluminum. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth properly balanced shade operation.
  - 5. Shade operation: Manual - with continuous loop bead chain, clutch, and cord tensioner and bracket lift operator.

### **PART 3 - EXECUTION**

#### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.02 ROLLER SHADE INSTALLATION AND ADJUSTING

- A. Remove existing roller shades and replace shade fabric.
- B. Re-Install roller shades . Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

#### 3.03 CLEANING AND PROTECTION

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

- B. Remove surplus materials, rubbish, and debris resulting from installation upon completion of work, and leave areas of installation in neat, clean condition.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, which ensure that roller shades are without damage or deterioration at time of Substantial Completion.

#### 3.04 SCHEDULE

- A. Provide roller shades at the following locations:
  - 1. Exterior windows along Corridor CR202.

**END OF SECTION**

## **SECTION 23 0600**

### **AIR DISTRIBUTION & ACCESSORIES – HVAC**

#### **PART 1 – GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.
- B. Refer to Section 230200 for HVAC General Provisions
- C. Refer to Section 230210 for HVAC Basic Materials & Methods.
- D. This Contractor shall coordinate with the work of Division 26 and the Fire Alarm System vendor for locations and mounting of all duct smoke detectors. These devices are shown on the Mechanical Drawings for reference only to show the intent of the work. All locations shall be determined based on approved shop drawings from the Fire Alarm System vendor and the Contractor for the work of Division 26, Electrical. Mount smoke detectors in the supply and return air stream at each unit in accordance with NFPA 72.

##### **1.2 DESCRIPTION OF WORK**

- A. This Section includes labor, material, equipment and supervision to provide a complete air distribution system as specified herein and as shown on drawings.
  - 1. Ductwork – Single Wall, Square and Rectangular
  - 2. Flexible Connections
  - 3. Dampers
  - 4. Air Diffusers, Registers and Grilles
  - 5. Fabric Air Dispersion System
  - 6. Roof-Mounted Relief Hoods
  - 7. Prefabricated Roof Curbs and Equipment Supports
  - 8. Roof-Mounted Intake/Exhaust Ventilators
  - 9. Sound Attenuators
  - 10. Flexible Air Duct
  - 11. VAV Units with Reheat

##### **1.3 REFERENCE STANDARDS**

- A. Refer to Section 230200 for a general description of requirements applying to this section.
- B. Requirements established within the portions of the Project Manual titled Division 1, General Requirements, are collectively applicable to the work of this section.
- C. IMC (International Mechanical Code).
- D. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.)
- E. American Society of Heating, Refrigerating and Air Conditioning Engineers' recommendations in ASHRAE Guide shall apply to this work.
- F. ARI Standard 885 - Standard for Estimating Occupied Sound Levels in the Applications of Air Terminals and Air Outlets.
- G. UL (Underwriter's Laboratories, Inc.)
- H. NFPA 90A shall apply to this work.

I. State Fire Prevention Regulations.

1.4 QUALITY ASSURANCE

- A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 230200.
- B. Submit the following:
1. Shop drawings of all sheet metal. Indicate all steel, piping, conduit, and Architectural/Structural features to demonstrate complete coordination. Scale shall not be less than 1/4".
    - a. Shop drawings shall indicate the sizes and lengths of each section of ductwork as well as all system components such as coils, VAV boxes, access doors, dampers, diffusers and register locations. Also indicate the type of joints used and where internal acoustic lining or insulation, if required, will be utilized.
    - b. The location of the duct runs and the air outlets shall be closely coordinated with all other trades by the sheet metal contractor to avoid interference. The shop drawings shall show the contact surfaces adjacent to the ducts or air outlets and the space assigned for concealment. The drawings shall indicate principal items of equipment, adjacent piping and conduit, etc., the location of which shall be secured from the contractors of other trades.
    - c. Sheet Metal Contractor to include resubmissions of the shop drawings to the Engineer. The resubmissions are to include all corrections to previous submissions.
  2. Manufacturer's literature and performance data of all equipment and devices.
  3. Samples: Furnish color samples, etc., at request of the Architect.

1.6 SUBSTITUTIONS

- A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY GUARANTEE

- A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

**PART 2 – PRODUCTS**

2.1 DUCTWORK (SINGLE WALL, SQUARE AND RECTANGULAR)

- A. All ductwork shall be fabricated in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible" latest Edition except as described below. The minimum thickness of metal ductwork is 26 gauge. Fabrication requirements shall be based on ductwork subjected to positive or negative pressures of 3" W.G. Ductwork systems shall be sealed to SMACNA "Seal Class "B" Standards. Alternatively, "Ductmate" System 45 can be used in accordance with manufacturer's specifications. Drive slip joints are not permitted.

Exception: For ductwork smaller than 12" x 8", Contractor may provide slip and drive joints with all joints sealed with Hardcast tape and mastic system.

- B. Rectangular ducts for 3" W.G. or less, positive or negative pressure shall be per SMACNA Table 1-6. Longitudinal seams shall be Pittsburgh Lock Type L-1 per SMACNA Figure 1-5. Transverse joints shall be standing seam type T -15 per Figure 1-4.
    - 1. In the event that material size is not compatible with duct size and segmenting must be utilized to fabricate duct, use SMACNA Figure 1-5, seam L-4 (Standing Seam).
  - C. Joints:
    - 1. Per SMACNA Transverse Joint Reinforcement Table 1-12, only joints T -22, T -25a, T -25b and Proprietary slip on flanges will be acceptable.
    - 2. Joints T -25a and T -25b that have stress fractures from bending will not be accepted.
    - 3. All joints will have butyl gasket 3/16" thick by 5/8" wide installed per manufacturers installation instructions.
  - D. Ductwork systems for this standard shall be galvanized sheet steel, commercial quality of lock - forming grade, conforming to ASTM coating standards A-525 or A-527 with coating of designation G-60. For corrosive or moist conditions, use coating designation G-90.
    - 1. Where the outer surface of the duct is exposed in finished spaces and is not scheduled for insulation, duct material shall be galvanized, suitable for field painting by the General Contractor.
  - E. The size and configuration of each duct shall be indicated on design drawings. Where thicker sheets or different types of materials are required, they shall be specified on the design drawings or in the project specifications.
  - F. Aluminum Rectangular Ductwork:
    - 1. Aluminum ductwork shall be two B.& S. gauges heavier than specified for the equivalent width steel ductwork. Bracing, supports and joints shall be as specified for steel ductwork.
    - 2. Aluminum ducts shall be used where the ducts are concealed when exhausting saturated air from dishwashing, showers, outside air intakes and similar designated spaces.
- 2.2 FLEXIBLE CONNECTIONS
- A. Required between ductwork and suction and discharge connection of all fans and air handlers.
  - B. Material: Woven fiberglass with mounting hardware tested in accordance with UL Standard 181, listed and labeled as Class 0 or 1.
  - C. Manufacturer: Ventfabrics, Inc., Durodyne, Dynair, Ductmate Pro Flex.
- 2.3 DAMPERS
- A. Provide where indicated and required to control flow of air and balance system.
  - B. Round dampers shall be single blade, molded synthetic bearings at each end, 20 gauge galvanized steel, adjusting quadrant and locking device. Round dampers shall be Ruskin Model MDRS25.
  - C. Rectangular and square dampers shall be opposed blade within 16 gauge galvanized steel channel frame with corner brace, 16 gauge galvanized steel blades; molded synthetic bearings and hex steel shafts, exposed or concealed linkage, adjustable quadrant and locking device. Damper 10" and below shall be single-blade. Dampers shall be Ruskin Model MD35.
  - D. Approved Manufacturers: Ruskin, Arrow, Nailor-Hart, Pottorff, Lloyd Industries, Inc., Cesco Products, Louvers & Dampers, United Enertech.
- 2.4 AIR DIFFUSERS, REGISTERS AND GRILLES
- A. Air diffusing terminals shall be provided in duct runs on drawings. The diffusers shall properly and uniformly distribute the design air quantity with no objectionable drafts, while maintaining not more than 50 F. P. M. velocity in the occupied portion of the space.



B. Ceiling Diffusers:

1. Square Louvered Diffuser Face:

- a. Square housing, welded steel construction core of square concentric louvers, removable at face of diffuser, round duct connection, with borders suitable for lay-in ceiling tile application.
- b. Diffuser Patterns: Fixed louver face for 1, 2, 3, or 4 direction air flow, direction indicated on drawings.
- c. Finish: Matte white finish.
- d. Manufacturers: Krueger SH (SHR for round neck)

2. Linear Diffusers:

- a. Linear diffusers shall be horizontal continuous slot type with multiple slots per the schedule and drawings. Construction shall be extruded aluminum with 1/2", 3/4" or 1 " slots. The diffusers shall have integral devices to equalize air flow over the entire length of the diffuser.
- b. Multiple sections of diffusers shall be installed in a continuous arrangement, the butt ends shall be provided without flanges to provide a continuous effect. Multiple sections shall be aligned and fastened with alignment pins and slots or a similar method.
- c. Linear diffusers shall be provided with adjustable vanes to provide horizontal, vertical or midway patterns of air diffusion. Finish as selected by Architect.

3. Round Cone Diffusers:

- a. Adjustable round cone diffuser, welded steel construction with round neck and removable inner assembly of cones.
- b. Air pattern shall be field adjustable from horizontal to vertical.
- c. Finish: Matte white finish
- d. Krueger RM2

C. Registers & Grilles:

1. Registers and grilles shall be steel construction, fixed single deflection type, with clips and/or flange holes and screws (as required by Architectural finishes) to secure registers to ceiling construction. Face bars shall be inclined 30 degrees. Registers and grilles shall be factory primed and painted with a baked-on white enamel finish.

2. Wall Supply Registers:

- a. Provide manufacturer's standard wall registers where shown; of size, shape, capacity, type of materials and components indicated.
- b. Register Materials: Steel construction: Manufacturer's standard stamped sheet steel frame and adjustable blades.
- c. Register Faces: Vertical Straight Blades: Horizontal blades, individually adjustable, at manufacturer's standard spacing.
- d. Register Patterns: Double Deflection: 2 sets of blades in face, rear set at 90 degrees to face set.
- e. Register Finishes: Aluminum Enamel: Air-dried aluminum enamel prime finish.

3. Ceiling Return Register (CR):

- a. Ceiling registers shall have a perforated face with 3/16-inch diameter holes on 1/4-inch staggered centers and no less than 51 percent free area. Perforated face shall be

aluminum according to the model selected. The back pan shall be one piece stamped heavy gauge steel of the sizes and mounting types shown on the plans and outlet schedule.

- b. The finish shall be #26 white. The finish shall be a baked on anodic acrylic paint, with a pencil hardness of HB to H. Inside of back pan shall be painted flat black.
- c. Krueger 6490 Sq neck/6690 Rd. neck
- 4. Supply, Return, Exhaust and Transfer Grilles (SG, RG, EG & TG):
  - a. Grilles shall be available parallel to the long dimension of the grille. Construction shall be of steel with a 1 1/4-inch wide border on all sides. Screw holes shall be countersunk for a neat appearance. Corners shall be welded with full penetration resistance welds.
  - b. Deflection blades shall be firmly held in place by mullions from behind the grille and fixed to the grille by welding in place. Blade deflection angle shall be available at 35°.
  - c. The finish shall be #26 white. The finish shall be a baked on anodic acrylic paint, with a pencil hardness of HB to H.
  - d. Krueger 880 & S85
- D. Manufacturers: Provide diffusers, registers and grilles of one of the following:

Anemostat	Price
Carnes Co.	Titus
Krueger	Tuttle & Bailey
Metalaire	Nailor Industries

## 2.5 FABRIC AIR DISPERSION SYSTEM

- A. Round fabric air dispersion system shall be constructed of FabricAir® Trevira CS 100 fabric. The fabric is a woven inherently fire retardant and permeable fabric complying with the following characteristics:
  - 1. Duct Shape: Round
  - 2. Fabric: 100% Inherently Flame Retardant Polyester
  - 3. Weight: 7.2 oz./yd<sup>2</sup> per ASTM D3776
  - 4. Shrinkage: Max. 0.5% per EN ISO 5077
  - 5. Color: STANDARD
  - 6. Temperature Range: -40°F and +176°F
  - 7. Base Permeability @ 0.5" WG: 2.28 CFM/SQFT per ASTM D737, shall be verified by the Frazier Permeability Test
  - 8. Fire Retardancy: Shall meet the requirements of NFPA 90-A, ICC AC167 and UL 2518
  - 9. Manufacturer shall provide a 10-year non-prorated warranty. Prorated warranties will not be accepted.
- B. System Fabrication Requirements
  - 1. The system is made with sewn in, but still removable, aluminum hoops. The rods support the shape of the fabric system by 180° (8"-48"), 120° (49"-60"), 90° (61"-68") and 60° (69"-80"). Hoops must be pre-installed from factory, no installation at sight. Diameter of hoops and distance between as specified by manufacturer.
  - 2. Elbows of 70° or more to have 2 hoops sewn in order to maintain shape.

3. Air dispersion shall be accomplished by dispersion through permeable fabric. Due to exact requirements of draft and NC requirements alternative flow models are not acceptable.
4. The system shall be made of permeable fabric. Base permeability of fabric shall be reached based on a combination of weave construction and a thermo fixation process in order to prevent permeability degradation after wash. Fabric permeability based on a calendering process is not acceptable.
5. Fabric system shall include connectors to attach to suspension system listed below.
6. Provide system in sections optimized for maintenance, connected by zippers. Zippers shall provide closure completely around the circumference to prevent leakage. Required number of zippers shall be specified by the manufacturer.
7. Each section to have a unique tag including information about manufacturers order number, position, diameter of section, length of section, maintenance instruction, code compliance and contact details for spare parts.

C. Design Parameters

1. Use fabric air diffusers only for positive pressure air distribution.
2. Do not use fabric air diffusers in concealed locations.
3. Fabric diffusers shall be designed to a maximum of 3" water gauge, with 0.5" being the standard.
4. Design temperatures shall be between -40°F and +176°F
5. Manufacturer shall approve all technical design parameters.

D. Hangers and Supports

1. Type 8: One row H-rail/cable system located 2" above 12 o'clock of FabricAir® system. Hardware to include H-rail joint, eye bolt, end cap H-rail, cable, tie down strap and H-rail as required. FabricAir® system shall be attached to hardware using one single row of plastic sliders located 12 o'clock spaced 20 inches.
2. Hardware
  - a. Anodized Aluminum H-Rails - With PVC coated Galvanized Steel suspension cable. Suspension cable clamps, H-rail suspension eyebolts, and all other factory supplied metal components shall be Galvanized Steel.
  - b. PVC Coated Galvanized Steel Tensioning and Suspension Cable - Cable clamps, cable tensioners, and all other factory supplied metal components shall be Galvanized Steel.

- E. Manufacturers: Fabric Air Inc, Duct Sox by Fabric Air Dispersion Products, or KE Fibertec.

2.6 ROOF-MOUNTED RELIEF HOODS

- A. Heavy gauge aluminum construction.
- B. Hinged hood.
- C. Hood underside insulated with 1" fiberglass
- D. Aluminum insect screen
- E. Provide 12-inch-high insulated roof curb.
- F. Manufacturers: Penn Ventilator Co., "Airette", Carnes Co., Greenheck, Loren Cook or Acme

2.7 PREFABRICATED ROOF CURBS AND EQUIPMENT SUPPORTS

- A. Factory fabricated by the manufacturer of the respective roof-mounted equipment when available and capable of meeting the following requirements:
  1. Thermally and acoustically insulated, rubber isolating pads.

2. Built to suit slope of roof and type of roofing; i.e. standing metal seam with integral cant strip and flashing extension.
  3. 8" to 12" height unless otherwise indicated.
  4. Support rails shall be aluminum, or sheet steel, with continuous wood nailer and removable counterflashing.
- B. Curbs shall be a product of a custom manufacture in the following cases:
1. Curbs as specified are not available from the respective equipment manufacturer.
  2. Piping or ducts penetrating roof.
  3. Prefabricated equipment supports are required.
  4. Step flashing assembly, EPDM for normal use and silicone for pipe temperatures above 200°F stainless steel clamp, suitable for single or multiple pipes.
- C. Pipe supports shall be a product of a custom manufacture equal to Pipe Prop as made by JMB Industries, or Anvil International Haydon H-Block.
- D. Manufacturers: Pate, Shipman, Custom Curb, Portals Plus, Lloyd Industries, Inc., PHP Systems/Design.
- 2.8 ROOF-MOUNTED INTAKE/EXHAUST VENTILATORS
- A. Heavy gauge aluminum construction.
  - B. Hinged hood.
  - C. Hood underside insulated with 1" fiberglass.
  - D. Aluminum insect screen.
  - E. Provide 12-inch-high insulated roof curb with blocking.
  - F. Manufacturers: Penn Ventilator Co., Carnes Co., Greenheck, Loren-Cook or Acme.
- 2.9 SOUND ATTENUATION
- A. Provide silencers of the types and sizes shown on plans.
- B. Materials and Construction:
1. Outer casings of rectangular silencers shall be made of 22-gauge galvanized steel in accordance with ASHRAE Guide recommended construction for high pressure rectangular duct work. Seams shall be lock formed and mastic filled.
  2. Outer casings of tubular silencers shall be made of galvanized steel.
  3. Interior partitions for rectangular silencers shall be made of not less than 26 gauge galvanized perforated steel.
  4. Interior construction of tubular silencers shall be compatible with the outside casings.
  5. Filler material shall be of inorganic mineral or glass fiber of a density sufficient to obtain the specified acoustic performance and be packed under not less than 5 % compression to eliminate voids due to vibration and settling. Material shall be inert, vermin and moisture-proof.
  6. Combustion rating for the silencer acoustic fill shall be not less than the following when tested in accordance with ASTM-E-84, NFPA Standard 255 or UL No. 723:

Flamespread Classification	25
Smoke Development Rating	15
Fuel Contribution	20

7. Airtight construction shall be provided by use of a duct sealing compound on the job site. Material and labor furnished by contractor. Silencers shall not fail structurally when subjected to a differential air pressure of 8 in. w.g. inside to outside of casing.
  - C. Acoustic Performance: Silencer ratings shall be determined in a duct- to-reverberant room test facility which provides for airflow in both directions through the test silencer in accordance with ASTM Specification E-477. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves and test chamber sound absorption are eliminated. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self- Noise (SN) Power Levels both for Forward Flow (air and noise in same direction) and Reverse Flow (air and noise in opposite directions) with airflow of at least 2000 fpm entering face velocity.
  - D. Aerodynamic Performance: Silencer shall be of the low static pressure loss type. Airflow measurements shall be made in accordance with ASTM specification E-477 and applicable portions of ASME, AMCA and ADC airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented.
  - E. Certification: With submittals, the manufacturer shall supply certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance for Reverse and Forward Flow test conditions. Test data shall be for a standard product. All rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection upon request from the Architect/Engineer.
  - F. Manufacturers: Pottorff, Industrial Acoustics Co., Rink, Commercial Acoustics, Dynasonics, BRD, Vibro-Acoustics, Price.
- 2.10 FLEXIBLE AIR DUCT
- A. Insulated flexible air duct shall be non-metallic. Air duct shall comply with the latest NFPA Bulletin No. 90A and be labeled as Class 1 Air Duct, U.L. Standard No. 181.
  - B. Air ducts shall be suitable for working pressure of not less than plus 10.0 and minus 0.5 inches of W.G.
  - C. Non-metallic air duct shall be two element spiral construction composed of a corrosion resisting metal supporting spiral and a vinyl coated fiberglass base fabric and shall be mechanically interlocked together.
  - D. Insulation shall be 1-1/2" thick fiberglass flexible blanket with vapor barrier outer jacket of polyethylene or reinforced mylar. Maximum thermal conductance of 0.23 Btu/Hr./SF/Inch at 75 deg. F temperature.
  - E. Approved manufacturers shall include the Wiremold Company, Flexmaster USA, Owens-Corning, Thermaflex Flex Vent.
- 2.11 VAV UNITS WITH REHEAT
- A. Terminal units designated shall be pressure independent type and of sizes shown on drawings or terminal unit schedule. Units shall have factory catalog performance ratings which conform to CFM, Heating Capacity, Static Pressure discharge and radiated sound power and attenuation designated.
  - B. Cabinets shall be constructed of not lighter than 22 gauge, zinc-coated steel with factory applied enamel paint finish. Internal surfaces shall be acoustically and thermally insulated with 1 inch glass fiber material surface-treated to prevent erosion and having U.L.181 approval meeting NFPA 90A.
  - C. Heating coil shall be copper tube, aluminum fin. Coil performance data shall be based on test in accordance with AHRI Standard 410.

- D. Air volume damper shall be constructed to prevent air leakage in excess of 2% of rated air quantity at 1" inlet static pressure.
- E. Automatic damper operators shall be factory installed and thoroughly tested for proper performance.
- F. Performance of units shall be based on tests conducted in accordance with AHRI Standard 880 Certification Program.
- G. Units shall be as manufactured by Trane, Carrier, Titus, Price.

### **PART 3 – EXECUTION**

#### **3.1 DUCTWORK**

- A. Dimensions on drawings are inside dimensions. Sheet metal dimensions shall be increased to suit thickness of acoustic duct lining, if applicable. Ductwork that is lined with acoustic lining is insulated.
- B. Ducts shall be concealed unless otherwise indicated.
- C. Changes in direction shall be made with radius bends or turning vanes.
- D. Supports shall be galvanized steel for steel ductwork and aluminum for aluminum ductwork.
- E. Locate ceiling air diffusers, registers, and grilles on "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.
- F. Do not install ductwork directly above any electrical equipment.
- G. Ductwork shall be supported per SMACNA Standards except as follows:
  - 1. Rivet or screw to side of duct when using flat strap hangers. Rivet or screw to bottom of duct when using trapeze hangers.
  - 2. Extend hangers down the side of the duct at least 9"; pass hangers under ducts less than 9" deep.
  - 3. Space hangers not more than 8' on centers for ducts up to 18" wide and 4' on centers for ducts over 18" wide.
  - 4. Wire hangers are not acceptable.
  - 5. Support ductwork from building structure with expansion bolts, rods, steel angles or channels installed to meet existing or new building conditions.
  - 6. Drilling into the roof deck is not permitted.
  - 7. Driving nails into anchors is not permitted.
- H. Air Flow Control:
  - 1. Major take-offs: Install volume control dampers.
  - 2. Branches: Install volume control dampers in all branches and at tap in branch take-off connections.
  - 3. Elbows: Use unvaned elbows with throat radius equal to width of duct and full heel radius; provide turning vanes where full throat and heel radius are not possible.
  - 4. Transitions: Make transitions in ducts as required by structural or architectural interferences.
    - a. Proportion airways to compensate for any obstructions within duct.
    - b. Avoid dead ends and abrupt angles.
    - c. Do not exceed 15 degrees slope on sides of transitions.
- I. For all exterior single wall, square or rectangular ductwork, ensure that the top of all horizontal ductwork is crowned to minimize accumulation of weather on top of the finished insulation

system jacket specified in Section 230230.

- J. Ductwork on the roof shall be supported by an engineered, prefabricated hanger system specifically designed for installation on the roof without roof penetrations, flashing or damage to the roofing material. The system shall consist of bases made of high density polypropylene plastic with additives for UV protection, hot dipped galvanized structural steel frames, hangers, fasteners, rods, etc. The system shall be completed and designed to fit the ductwork installed under actual conditions of service. The system shall be furnished as manufactured by PHP Systems & Design or Anvil International Haydon H-Block. (Designer Choice)

### 3.2 FLEXIBLE AIR DUCT

- A. When flexible duct is used for final connection between duct mains on branches and diffusers on registers. The maximum length of flexible ductwork shall be 5'-0" in length.
- B. Flexible ductwork shall be properly hung at the tap collar in order to prevent eventual wear and damage to the flexible duct.
- C. The ceiling tile system should not be considered a support on which to lay flexible duct. Refer to SMACNA Standards for proper installation.

### 3.3 DUCT SYSTEM LEAK SEALING

- A. Joints in duct systems at duct heaters, air monitors, fire dampers, sound traps, supply air terminals including air handling light fixtures, shall be sealed to prevent air leakage.
- B. All duct joints and seams in medium pressure and high-pressure duct systems shall be sealed to SMACNA Seal Class "A" Standards to prevent air leakage.
- C. In the event there is in excess of 5% air leakage indicated in low pressure duct systems, it shall be the Contractors responsibility to seal the duct system. The amount of sealing necessary shall be that required to obtain the design air quantity at each terminal.
- D. Duct sealing shall be by means of high velocity duct sealants such as Hardcast and/or Neoprene gaskets. Type of sealant and method of application shall conform to recommendations in SMACNA high velocity duct construction standards.

### 3.4 DUCTWORK TESTING

- A. The following duct systems shall be pressure leak tested:
  - 1. Supply ductwork
  - 2. Return ductwork
  - 3. Exhaust ductwork
  - 4. Outside air intake ductwork
- B. Pressure leak test the following:
  - 1. 10% of all ducts (Large Projects)
  - 2. 100% of all major equipment (ERUs, RTUs, AHUs, EFs, etc.)
- C. All tests shall be conducted in accordance with AABC National Standards.
- D. Ducts to be tested at 100% maximum of static pressure before any duct is insulated externally and concealed in accordance with SMACNA Standards.
- E. Calculate the allowable leakage using leakage factor of 5% of Design Air Flow.
- F. Select a limited section of duct for which the estimated leakage will not exceed capacity of the test apparatus.
- G. Connect the blower and flow meter to the duct section and provide temporary seals at all openings of the ductwork.

- H. Start the blower motor with the inlet damper closed. Increase pressure until the required level is reached.
- I. Read the flow meter and compare the leakage in cfm. Reading should be 5% or less of design flow for the duct segment being tested.
- J. If reading is more than 5% of design flow, depressurize duct, repair all leaks and retest until 5% or less of design flow is obtained.
- K. Complete test reports and obtain Owner's witness signature.
- L. Remove all temporary blanks and seals.
- M. Warning: Do not overpressure duct.

### 3.5 EQUIPMENT

- A. Test apparatus shall consist of an airflow measuring device, flow producing unit, pressure indicating devices and accessories necessary to connect the metering system to the test specimen.
- B. The Contractor conducting tests shall arrange for or provide all temporary services, all test apparatus, all temporary seals and all qualified personnel necessary to conduct the specified testing.
- C. Test apparatus shall be accurate within plus or minus 7.5% at the indicated flow rate and test pressure and shall have calibration data or a certificate signifying manufacture of the meter in conformance with the ASME Requirements for Fluid Meters. Verification of above, to be supplied to Owner upon request.
- D. Pressure differential sensing instruments shall be readable to 0.05" scale division for flow rates below 10 cfm or below 0.5" w.g. differential. For flows greater than 10 cfm scale divisions of 0.1" are appropriate. U-tube manometers should not be used for reading less than 1" of water.
- E. Liquid for manometers shall have a specific gravity of 1 (as water) unless the scale is calibrated to read in inches of water contingent on use of a liquid of another specific gravity, in which case the associated gauge fluid must be used.
- F. Instruments must be adjusted to zero reading before pressure is applied.

### 3.6 TEST REPORT

- A. Log the project and system identification data.
- B. Enter the fan CFM, the test pressure, and the leakage class specified by the designer.
- C. Enter an identification for each duct segment to be tested.
- D. Calculate the allowable leakage factor. Enter this number on the report for each test segment.
- E. Conduct and record the field tests. If the sum of the CFM measured is less than or equal to the sum of the allowable leakage, the test is passed. Record the date(s), presence of witnesses and flow meter characteristics.
- F. Maintain a mechanical duct plan of all tested duct segments. Plan to include duct segment identification and dates tested.
- G. Test reports shall be submitted as required by the project documents.

### 3.7 LABELING

- A. At all fire damper locations, access doors in ductwork shall be identified with a permanent placard of red-white-red laminated commercial grade plastic construction, minimum one-half inch high capital letters, reading, "FIRE DAMPER" as appropriate for the installation. Attach securely to face of access door with brass screws at each corner, sealed airtight.

END OF SECTION 23 0600



**SECTION 23 0760**  
**AIR HANDLING EQUIPMENT**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.
- B. Refer to Section 230200 for HVAC General Provisions
- C. Refer to Section 230210 for HVAC Basic Materials & Methods.
- D. Refer to Section 230450 for Refrigeration Equipment – HVAC.

**1.2 DESCRIPTION OF WORK**

- A. This Section includes work necessary and/or required and materials and equipment for construction of a complete system. Such work includes, but is not limited to the following:
  - 1. Packaged Air-to-Air Energy Recovery Unit
  - 2. Air Handling Units

**1.3 REFERENCE STANDARDS**

- A. Refer to Section 230200 for a general description of requirements applying to this section.
- B. AMCA Standards 210 and 300 for fans.
- C. ARI Standard 410, ASHRAE Standard 33 for Heating and Cooling Coils.
- D. ASHRAE Standard 52.2 and U.L. Standard 900 for media type air filters.
- E. AMCA Standard 511 and 500D for Air Control Dampers.
- F. AMCA Standard 611 and 610 for air flow measurement stations.
- G. ARI Standard 1060 and ASHRAE Standard 84 for Air-to-Air Energy Recovery Equipment.
- H. ARI Standard 260 and 430 for Air Handling Units.

**1.4 QUALITY ASSURANCE**

- A. Refer to Section 230210 for a general description of requirements applying to this Section.
- B. Whenever a variable frequency PWM drive is installed to control an AC motor, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor drive end to discharge shaft currents to ground. Recommended part: AEGIS SGR™ Bearing Protection Ring, as made by Electro Static Technology. Install in accordance with the manufacturer's written instructions.

**1.5 SUBMITTALS**

- A. Submit shop drawings in accordance with Section 230200.
- B. Submit shop drawings and descriptive data for all equipment specified in this section.

**1.6 SUBSTITUTIONS**

- A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items provided by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by

other trades.

#### 1.7 WARRANTY/GUARANTEE

- A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements. In addition, the following special guarantee applies:

1. Each compressor unit shall be provided with manufacturer's five (5) year parts and labor warranty.

### PART 2 – PRODUCTS

#### 2.1 PACKAGED AIR-TO-AIR ENERGY RECOVERY UNIT

- A. Factory fabricated and assembled unit consisting of constant volume fans, motors, and drive assemblies, coils, plenum casing, filters, energy recovery wheel (with motor and drive), motor-operated outside air and exhaust air dampers, access doors and operating controls.

B. Casing:

1. Casing panels shall consist of dual wall, minimum 18-gauge galvanized solid exterior skins and 22-gauge galvanized steel solid interior skins enclosing 2" thick 1.5 pcf fiberglass insulation with a minimum R-value of 10 which meets NFPA 90A and UL181 test standards. All metal-to-metal surfaces exposed to the weather shall be sealed airtight with maximum leakage not-to-exceed 2% at external static pressure of 3" W.C.
2. Removable panels shall be provided for energy recovery wheels, and fans. The housing shall be supported by an all-welded epoxy-painted structural base. Lifting lugs shall be welded to the base. All frame and panel members shall be G90 galvanized steel.
3. Access to all internal devices and sections shall be provided through hinged, sealed doors. Access doors shall be constructed of the same materials as the unit casing. Each door shall be provided with two cam type handles and two heavy duty hinges to achieve maximum sealing. Handles are to be internal and external for opening from the inside or outside of the unit.
4. The unit's duct connections shall be arranged to require only minor ductwork offsets or transitions to the packaged heating/cooling unit.
5. Unit features and casing shall be of weatherized construction including:
  - a. Continuous 18 gauge galvanized steel, pitched watertight roof with standing seams.
  - b. Gasketed sections requiring no caulking at the job site.
  - c. Internal galvanized steel drain pans in each section.
6. Provide cabinet extensions adjacent to each coil section of sufficient size to accommodate piping valves and accessories as detailed on the drawings. Cabinet extensions shall be an integral part of the unit and its support curb, equal in construction, with openings down through the roof deck to allow building air to penetrate the compartment.

C. Fans:

1. Fan ratings are based on tests made in accordance with AMCA Standard 210 and shall bear the AMCA Seal. Fans shall be of the centrifugal type, designed with a scroll type housing. Fans shall incorporate a wheel, structural steel frame and shaft and bearings in the AMCA Arrangement 3 configuration to form a heavy duty integral unit. All fan wheels shall provide stable flow and high rigidity. The wheels shall be non-overloading type. The blades shall be continuously welded, die-formed backward curved type, designed for maximum efficiency and quiet operation. Impellers shall be statically and dynamically balanced and the complete fan assembly shall be test balanced at the operating speed prior to shipment.

2. Shafts shall be AISI hot rolled steel accurately turned, ground, polished, and ring gauged for accuracy. Shafts shall be sized for first critical speed of at least 1.43 times the maximum speed for the class.
3. Bearings shall be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for minimum average bearing life (AFBMA L-10) in excess of 100,000 hours at the maximum class RPM.
4. Fans shall be mounted on vibration bases with adjustable motor bases, V-belt drives, minimum 1" static deflection spring isolators, and flexible connections. Belts shall be designed for a minimum 1.5 service factor. Drives for motors shall be variable pitch.
5. Motors shall be standard NEMA frame, design B high efficiency, with 1.15 service factor and open drip-proof enclosures. Motor selections shall be non-overloading over the fan curve from 0 to 150% of design flow, and the design BHP shall not be above 90% of motor horsepower at design condition.

D. Total Energy (Enthalpy) Recovery Wheel:

1. The rotor media shall be made of aluminum which is coated to prohibit corrosion. All media surfaces shall be light weight polymer coated with a permanently bonded Silica gel desiccant prior to being formed into the honeycomb media structure to ensure that all surfaces are coated and that adequate latent capacity is provided. Desiccant coatings that must be reapplied over time are not acceptable.
2. Sensible and latent recovery efficiencies shall be clearly documented through a certification program conducted in accordance with ASHRAE 84-1991 and the results shall be presented in accordance with ARI 1060-2000 Standards. The certification shall have been conducted by the unit manufacturer.
3. Wheel testing to document that the desiccant material utilized does not transfer pollutants typically encountered in the indoor air environment shall be provided. The cross-contamination and performance certification reports shall be provided for as part of the submittals for this project.
4. The media shall be cleanable with low temperature steam, hot water or light detergent, without degrading the latent recovery. Dry particles up to 650 microns shall pass freely through the media.
5. Rotor System:
  - a. Seals: The rotor shall be supplied with diameter and perimeter seals which shall not make contact with any rotating surface of the exchanger rotor face.
  - b. Rotor Support System: The rotor media shall be provided in segmented fashion to allow for field erection or replacement of one section at a time without requiring side access. The media shall be rigidly held by a structural spoke system made of stainless steel.
  - c. Rotor Housing: The rotor housing shall be a structural framework which limits the deflection of the rotor due to air pressure loss to less than 1/32". The housing shall be made of galvanized steel to prevent corrosion. The rotor shall be supported by two pillow block bearings which can be maintained or replaced without the removal of the rotor from its casing or the media from its spoke system. Bearings shall be selected for an L-10 life in excess of 30 years.
  - d. Drive System: The rotor shall be driven by a self-adjusting flexible, circumferential belt system. A/C motors shall be utilized.
  - e. Assembled system shall incorporate the complete wheel assembly, seals, drive motor and belts in an insulated cassette frame within a slide-out track.

- E. Filters:
  - 1. Provide filters for both inlet air streams, outside air and return air..
  - 2. Filters shall be disposable 2" thick, MERV 8. The filter shall be listed by Underwriters' Laboratories as Class 2.
  - 3. Provide a bank of galvanized universal holding frames arranged for upstream access.
- F. Electrical: 460 volt, 3 phase, 60 Hz; electrical features shall include single point power feed termination, unit-mounted lockable disconnect, internal circuit breaker type overload protection, starters, 24 VAC control transformer and fusing.
- G. Connections: System field connections shall be limited to:
  - 1. Supply air duct connection from the packaged unit.
  - 2. Return air duct connection to the packaged unit.
  - 3. Field supplied power source.
  - 4. Twisted pair, ATC communications wiring.
  - 5. Coil piping connections for water system piping and condensate drain.
- H. Coil Section:
  - 1. Provide coil section with auxiliary cooling and heating coils to maintain scheduled air conditions leaving the unit.
  - 2. Condensate drain pan shall be constructed of galvanized steel.
  - 3. Heating and Cooling Coils:
    - a. Coils shall be furnished to meet the performance requirements set forth in the schedule. All coils shall have performance certified in accordance with ARI Standard 410.
    - b. Coil casing to be constructed of 16-gauge galvanized steel with aluminum die-formed corrugated fins and guide channels to create turbulent wiping behind the tubes with collars drawn and belled. The copper tubes are to be firmly bonded to the fins by mechanical expansion.
    - c. Drainable water coils shall be designed to operate at 250 psig design working pressure and up to 200°F and shall be tested with 325 psig compressed air under water. Circuiting shall provide free draining and venting when installed, counter flow of air and water, with water velocities not to exceed 7 feet per second and without exceeding the water pressure drops scheduled. All coils must have same end connections regardless of the number of rows deep. Provide a 1/4" FPT, plugged vent or drain tap on each connection.
    - d. Coil connection shall stub through the interior partition wall between the supply and return air tunnels. Field piping to the coils shall extend down through the bottom pan of the unit within the unit roof curb. Pipe sleeves shall be sealed airtight.
- I. Roof Curb: Prefabricated galvanized steel mounting curb shall be provided for field assembly on the roof decking prior to unit placement. The roof curb shall be a perimeter type with complete perimeter support of the air handler unit. The curb shall be a minimum of 12" high. Gasketing shall be provided for field mounting between the unit base and roof curb. Curb shall include a 2" x 4" wood nailer.
- J. Manufacturers: Basis of design, Seasons4. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are limited to one of the following:

Annexaire  
York

Modine

Valent

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

## 2.2 AIR HANDLING UNIT

- A. Provide air handling units as manufactured by VTS, Manufacturer #1, or Manufacturer #2 provided the construction specifications capacities and performance criteria are met.
- B. Furnish and install where shown on the plans air handling units with construction features as specified below. The units shall be provided and installed in strict accordance with the specifications. All units shall be complete with all components and accessories as specified. Any exceptions must be clearly defined. The contractor shall be responsible for any additional expenses that may occur due to any exception made.
- C. Standard Factory Tests: The fans shall be factory run tested to ensure structural integrity and proper RPM. All electrical circuits shall be tested to ensure correct operation before shipment of unit. Units shall pass quality control and be thoroughly cleaned prior to shipment.
- D. Unit Construction Description
  1. General: Provide factory-fabricated air handling units with capacity as indicated on the schedule. Units shall have overall dimensions as indicated and fit into the space available with adequate clearance for service as determined by the Engineer. Units shall be completely assembled or multiple sectioned, shall be shipped as a single package (except where shipping limitations prevent) de-mounted into modular sections in the field by the contractor. Units shall be furnished with sufficient gasket and bolts for reassembly in the field by the contractor. Unit manufacturer shall provide certified ratings conforming to the latest edition of AMCA 210, 310, 500 and AHRI 410. All electrical components and assemblies shall comply with NEMA standards. Unit internal insulation must have a flame spread rating not over 25 and smoke developed rating no higher than 50 complying with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems." Units shall comply with NFPA 70, "National Electrical Code," as applicable for installation and electrical connections of ancillary electrical components of air handling units. Tags and decals to aid in service or indicate caution areas shall be provided. Units shall be UL or ETL listed.
  2. Rigging Provision – Multiple Piece Units: Units shipped in multiple sections shall be engineered for field assembly. All gasket and necessary assembly hardware shall ship loose with unit. Junction boxes with a factory supplied numbered terminal strip shall be supplied at each shipping split for reconnection of control wiring.
  3. Unit Casing – The construction of the air handling unit shall consist of a Non-skeleton structure made by a "C" or "L" sandwich 2.0 inch thick polyurethane foam with an external side 22 gauge coated steel and 25 gauge galvanized steel on the inside, making it a double wall construction. The coating on the exterior surface provides a minimum of 2,000 hours Salt Spray rated corrosion resistance (per ASTM B-117). All the elements are connected with sealed joints.
  4. Insulation - Entire unit to be insulated with a full (R13) 2" thick closed cell foam insulation. All insulation edges shall be encapsulated within the panel. All field penetrations must be completely sealed by installing contractor.
  5. Access Doors - The unit shall be equipped with a solid double wall insulated (same as the unit casing), hinged or latched access doors as shown on the plans. The doorframe shall be extruded

aluminum, with a built in thermal break barrier and full perimeter gasket. The door hinge assembly shall be made of composite material.

E. Unit Component Description

1. Unit Fans – All fans shall meet the air flow performance specified and shall not exceed the break horsepower or sound power levels specified on the mechanical equipment schedule. Fan performance shall be based on testing and be in accordance with AMCA Standards 210 and 300.

F. Fans

1. The fan shall include direct driven, arrangement up to 5 plenum fan constructed per AMCA requirements for the duty specified. Fans shall be classified as class II or class III as required; class I fans are not acceptable. Fan wheels shall be made of composite material or aluminum construction and rated in accordance with and certified by AMCA for performance. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed. The fan shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan's peak static pressure producing capability at the specified fan/motor speed. Each fan/motor assembly shall include a G90 galvanized steel motor support plate and fan base with internal RIS isolation.
2. All motors shall be standard foot mounted type TEFC selected at the specified operating voltage, RPM, and efficiency as specified or as scheduled elsewhere. Motors shall meet the requirements of NEMA MG-1 Part 30 and 31, section 4.4.2. Motors shall be as manufactured by Baldor, Siemens, Toshiba or WEG that operate at varying synchronous speeds as driven by an approved VFD. Motor HP shall not exceed the scheduled HP as indicated in the AHU equipment schedule(s). Steel cased motors and/or ODP motors are not acceptable. All motors shall include permanently sealed L10-400,000 hr bearings with shaft grounding to protect the motor bearings from electrical discharge machining due to stray shaft currents. Each fan wheel shall be dynamically balanced to BV-5 or better.
3. Multiple Fan Arrays - Each fan motor shall be individually wired to a control panel containing one VFD per fan with one serving as the primary VFD. Each VFD shall be sized for the HP of the accompanying fan motor contained in the fan array. Wire sizing shall be determined, and installed, in accordance with applicable NEC standards and local code requirements.

G. Heat Transfer Coils – Water Coil

1. Performance is to be certified under AHRI Standard 410. Coils exceeding the range of AHRI standard rating conditions shall be noted.
2. Single stacked cooling coils shall be mounted on rack to permit coils to slide out individually from the unit. Provide intermediate drain pans on all double stacked cooling coils. The intermediate pan shall drain to the main drain pan. Water coils shall be constructed of seamless copper tubing mechanically expanded into fin collars. All fins shall be continuous within the coil casing to eliminate carryover inherent with a split fin design.
3. Headers are to be seamless copper with die formed tube holes.
4. Connections shall be male pipe thread (MPT) with vent and drain. All coil connections shall be extended to the exterior of the unit casing by the manufacturer. Coils shall be suitable for 261 PSIG working pressure. Maximum leak tested pressure shall be 522 PSIG and maximum burst pressure shall be 1189 PSIG.
5. Water coils shall have the following construction:
  - a. 1/2" o.d. x .020" wall copper tube with .020" return bends
  - b. .006" aluminum fins

- c. Stainless steel casing for 4, 6, and 8 row coils and Galvanized casing for 1, 2, and 3 row coils.
- H. Condensate / Drain Pans - The drain pan shall be fabricated from stainless steel. All pans are to be pitched for complete drainage with no standing water in the unit. Provide stainless steel drain connection extended to the exterior of the casing. All drain connections shall be piped and trapped separately for proper drainage.
- I. Filters - Provide filters of the type indicated on the schedule. Factory fabricated filter sections shall be of the same construction and finish as the unit. Side service filter racks shall be fabricated from galvanized steel and include hinged access doors. Internal blank-offs shall be provided by the air unit manufacturer as required to prevent air bypass around the filters.
  - 1. Medium Efficiency MERV 8 Pleated filters – Provide 2” filters as specified on filter schedule. Filters shall be in compliance with ANSI/UL 900 – Test Performance of Air Filters. Option: Provide (#) total sets of media.
- J. Dampers – VTS model VS or approved equal. Dampers to be airfoil, opposed blade type. Frame and dampers to be constructed out of extruded 6060-T66 aluminum. Damper blades to be connected by FRP nylon infused gears for long life. Dampers to have square actuator shaft to prevent actuator slippage. Dampers to be AMCA certified.

### **PART 3 – EXECUTION**

#### **3.1 INSTALLATION**

- A. Verify that coils, filters, motors, drives and other components are matched with the proper unit.
- B. Assemble unit components following manufacturer's instructions for handling, testing and operation. Repair damaged galvanized areas, and paint in accordance with manufacturer's written recommendations.
- C. Vacuum clean interior of units prior to operation.
- D. Repair air leaks from or into casing that can be heard or felt during normal operation.
- E. Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- F. Support: Install and secure roof curb to roof structure, in accordance with National Roofing Contractor's Association (NRCA) installation recommendations and shop drawings. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing.
- G. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.
- H. The Mechanical Contractor shall own as part of his work, the following:
  - Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.
- I. Provide certified factory start-up and written report on all units.

#### **3.3 AUTOMATIC TEMPERATURE CONTROLS**

- A. Coordination of control work with the BAS shall include, but not be limited to, the following items as described in Section 230900: ATC.
- B. Constant volume rooftop units:
  - 1. The following items shall be provided by the equipment manufacturer:
    - a. Motor starters and overload protection.

- b. Control transformers.
  - c. Energy wheel motor, speed controller, defrost controller, rotation failure contact, and status contact.
  - d. Dampers and damper motors.
  - e. Terminal blocks for all wiring connections between equipment and control devices.
  - f. Analog air filter differential pressure sensor.
  - g. Manual reset freeze stat.
  - h. Variable frequency drives as scheduled.
  - i. Run status dry contact for each VFD.
2. The following items will be furnished by the BAS Contractor and installed by the equipment manufacturer:
- a. DDC Controller
  - b. Discharge air temperature sensor.
  - c. Discharge humidity sensor.
  - d. Return air temperature sensor.
  - e. Return air humidity sensor.
  - f. Temperature sensor at exhaust air outlet.
  - g. Current sensor for one phase of power feeding the supply fan, and/or unit exhaust fan.
  - h. Mixed air average temperature sensor.
  - i. Heating coil discharge air temperature.
3. The following items shall be field mounted and wired by the BAS Contractor:
- a. Discharge air temperature sensor.
  - b. Discharge humidity sensor.
  - c. Heating coil discharge air temperature sensor.
  - d. Manual reset freezestat (supplied by ATC).
- C. Rooftop Energy Recovery Units:
1. The following items shall be provided by the equipment manufacturer:
- a. Motor starters and overload protection.
  - b. Control transformers.
  - c. Energy wheel motor, speed controller, defrost controller and rotation failure contact.
  - d. Dampers and damper motors.
  - e. Terminal blocks for all wiring connections between equipment and control devices.
  - f. Analog air filter differential pressure sensor, each filter bank.
  - g. Manual reset freeze stat.
2. The following items will be furnished by the BAS Contractor and installed by the equipment manufacturer:
- a. DDC Controller.
  - b. Unit discharge air temperature sensor.
  - c. Heating and cooling coil discharge air temperature sensors.



- d. Discharge humidity sensor.
  - e. Return air temperature sensor.
  - f. Return air humidity sensor.
  - g. Temperature sensor at exhaust air outlet.
  - h. Current sensor for one phase of power feeding the supply and exhaust fans.
3. The following items shall be field mounted and wired by the BAS Contractor:
- a. Discharge air temperature sensor.
  - b. Discharge humidity sensor.
  - c. Heating coil discharge air temperature sensor.
  - d. Manual reset freezestat (supplied by ATC).
- D. The factory mounted DDC controllers shall be fully programmed with factory approved applications. Any modifications to these programs shall be done by factory trained personal or as approved by the DDC controls and unit equipment manufacturer.
- The unit equipment manufacturer shall provide coordination for start-up, check-out, and test of the factory mounted DDC controllers and network devices including the protocol translator. Any hardware and software necessary including labor shall be provided by the unit equipment manufacturer.
- The unit DDC controllers shall be networked to a standard protocol translator or gateway so system points shall be available for communications and control from the Building Automation System (BAS)/Automatic Temperature Controls (ATC) System. The protocols available from the protocol translator to the BAS/ATC System shall be BACNET (MSTP), LON or N2.
- System points shall be configured to the BAS/ATC System by the BAS/ATC System Contractor. The mapping of points to the BAS/ATC front-end/PC shall be done by the BAS/ATC Contractor. Any software or hardware necessary including labor to accomplish this work shall be provided by the BAS/ATC System Contractor.

END OF SECTION 23 0760

**SECTION 23 0900**  
**AUTOMATIC TEMPERATURE CONTROL**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Section 230200 and drawings are hereby made a part of this section as fully as if repeated herein.
- B. The Mechanical Contractor shall coordinate with the work of Division 26 and the Fire Alarm System vendor for locations and mounting of all duct smoke detectors. These devices are shown on the Mechanical Drawings for reference only to show the intent of the work. All locations shall be determined based on approved shop drawings from the Fire Alarm System vendor and the Contractor for the work of Division 26, Electrical.

**1.2 DESCRIPTION OF WORK**

- A. Provide labor, material and supervision necessary to install a complete direct digital control system of temperature controls to control all HVAC Systems, associated components and accessories as described herein.

**1.3 SUBMITTALS**

- A. Submit shop drawings and manufacturer's data sheets of all equipment.
- B. Submit manufacturer's certificates of conformance with applicable codes.
- C. Furnish point-to-point diagram of automatic temperature control system approval, including heating, ventilating and air conditioning equipment wiring diagrams where temperature control connections are required.
- D. Provide ten (10) copies of submittal data within thirty (30) days of contract award.
- E. Submittal shall consist of:
  - 1. System Architecture showing all digital and pneumatically actuated devices.
  - 2. Equipment lists of all proposed devices and equipment including data sheets of all products.
  - 3. Valve, damper and well and tap schedules showing size, configuration, capacity and location of all equipment.
  - 4. Data entry forms for initial parameters. Contractor shall provide English listing of all analog points with columnar blanks for high and low warning limits and high and low alarm limits, and a listing of all fan systems with columnar blanks for beginning and end of occupancy periods; and samples of proposed text for points and messages (for at least two systems of at least 15 points total) including sample 480-character alarm message. All text shall be approved prior to data entry.
  - 5. Wiring and piping interconnection diagrams including panel and device power and sources.
  - 6. Sketches of all graphics.

**1.4 QUALITY ASSURANCE**

- A. Insure that all work and equipment is installed in accordance with manufacturer's warranty requirements.
- B. Provide adequate supervision of labor force to assure that all aspects of specifications are being fulfilled.
- C. The system shall be engineered, programmed and installed by personnel trained and regularly employed by the control's manufacturer.

- D. Supplier shall have technical support to promptly respond within 24 hours or less to service calls to the site with technical staff, spare parts inventory and test and diagnostic equipment.
  - E. Codes and Approvals:
    - 1. The complete system installation shall be in strict accordance with national and local electrical codes. All devices designed for or used in line voltage applications shall be UL listed.
      - a. All microprocessor based devices shall be UL916 listed.
      - b. All electrical environmental control and monitoring devices shall be UL429 and/or UL873 listed.
    - 2. All electronic equipment shall conform to the requirements of FCC regulation Class B, Part 15, Section 15 governing radio frequency electromagnetic interference and be so labeled.
    - 3. The complete system shall conform to ANSI/ASHRAE Standard 135-2012, BACNET.
  - F. All system components shall be designed and built to be fault tolerant.
    - 1. Provide satisfactory operation without damage at 100% above and 85% below rated voltage and at +3 Hertz variation in line frequency.
    - 2. Provide static, transient, and short circuit protection on all inputs and outputs. Communication lines shall be protected against incorrect wiring, static transients and induced magnetic interference. Bus connected devices shall be A.C. coupled or equivalent so that any single device failure will not disrupt or halt bus communication.
- 1.5 ELECTRICAL WIRING
- A. All electrical wiring, components and accessories in connection with the Automatic Temperature Control System shall be furnished and installed by the control's contractor.
    - 1. Electrical Contractor shall provide all wiring to duct smoke detectors.
    - 2. Unless stated otherwise in the design documents, the ATC Contractor is responsible for providing control power to all valves, actuators, devices and components within the DDC System regardless of the selected voltage of those devices. This also includes all 120 volt power circuits required for devices, panels and control equipment.
    - 3. The ATC Contractor shall be responsible for providing the control interface between terminal unit condensate pumps and their respective units at the required voltage of these devices in order to shut down the terminal unit in the event of high water level in the condensate pump receiver.
  - B. Control wiring shall include all wiring necessary to interface with new controls, such as relays and transducers, and shall also include electric and electronic devices such as freezestats, electronic sensors, relays, flow switches and controlled devices such as valve and damper operators, both electric/electronic actuated devices. Pilot devices such as ON/OFF switches and thermostats installed in series with line voltage circuits shall be considered to be control wiring.
- 1.6 AUTOMATIC TEMPERATURE CONTROL
- A. Provide a DDC System of automatic temperature control which shall be as manufactured by Schneider EcoStruxure, as installed by Tri-M Group, LLC. The system shall be complete in all respects including labor, materials, equipment and services necessary.
  - B. All electrical wiring in connection with the installation of the automatic temperature control system shall be furnished and installed under the direct supervision of the control manufacturer.

## **PART 2 – PRODUCTS**

### **2.1 TEMPERATURE SENSORS**

- A. Solid state room sensors shall be of the wire wound resistance type element. Sensors shall be

equipped with visual readout and adjustment. Sensors shall be of the completely solid state type with no moving contacts. Printed circuit board under thermostat cover shall contain a low mass resistance type setpoint dial and amplifier. Provide test points for measuring output voltage. Sensors shall be direct or reverse acting as required for the sequence of operation.

- B. Sensors shall provide the application for night setback override.
- C. Sensors shall be mounted at ADA height (48" above floor).

## 2.2 SMOKE DETECTORS

- A. Duct type ionization smoke detectors shall be furnished by the Electrical Contractor and installed by the Mechanical Contractor in the supply and return air stream. The Electrical Contractor shall provide wiring from each detector to the Fire Alarm System panel.
- B. The Electrical Contractor shall provide an alarm output signal from the FAS panel to the BAS for unit shutdown.

## 2.3 ACTUATORS

- A. Electronic actuators shall be sized to operate their appropriate dampers and valves with sufficient reserve power to provide smooth modulating action or two-position action as specified.
- B. Provide integral, auxiliary switches for direct coupled actuators to indicate when a desired position is reached or to interface additional controls for a specific sequence.
- C. Align actuator with drive shaft, provide permanent mark to identify closed position of end device.

## 2.4 SENSOR TRANSMITTERS

- A. Duct and immersion sensors shall have minimum spans as required to meet the temperature requirements. Duct sensors shall have sensing elements of sufficient length and accuracy to measure average duct temperature in each location.
- B. Sensors shall be of corrosion resistant construction, tamperproof, suitable for mounting on a vibrating surface. Exposed capillaries shall be temperature compensated, and armored or installed in protective tubing.
- C. All sensing elements for water pipe mounting shall be of the rod and tube type with linear output and shall be furnished complete with separable protecting wells filled with heat conductive compound. Sensors shall be factory calibrated and tamperproof. If easily adjustable sensors are provided, they shall be located inside metal enclosures with cylinder lock and key to prevent unauthorized setting.
- D. Safety Devices: Provide the following:
  - 1. Low limit, electric type, with 20' long serpentine element, with manual reset, set for 37°F for "freeze" protection and 55°F for fan discharge application, unless otherwise noted.
  - 2. Air and water duty flow switches: Differential pressure type for fan and pump status.
  - 3. Carbon monoxide sensor/transducer/meter shall be analog type, requiring no field or periodic calibration, suitable for wall mounting.
    - a. Microprocessor controlled digital display of 0 to 250 ppm CO.
    - b. Analog output of 4 to 20 milliamps.
    - c. UL listed housing, suitable for an operating environment of 0 to 125 F/ 10 to 90% RH.
    - d. Repeatability of +/- 10% at 50 ppm; linearity of +/- 10%.
    - e. Power input of 3.5 watts at 24 VAC.
    - f. Make: Macurco inc. model CM-2B.

- g. Manufacturers: Air Test Technologies, Inc., Macurco, Rotronic Instrument Corp.,  
Vaisala, Inc.
- 4. Carbon dioxide sensor/transducer suitable for duct mounting.
  - a. Analog output of 4 to 20 milliamps corresponding to 0 to 2000 ppm CO<sub>2</sub>.
  - b. ABS plastic housing, suitable for an operating environment of 0 to 125 F/ 0 to 100% RH, non-condensing.
  - c. Repeatability less than +/- 20 ppm.
  - d. Response time less than 60 seconds.
  - e. Power supply, 24 VAC.
  - f. Make: Vaisala Inc. model GMD 20 (duct)
  - g. Manufacturers: Air Test Technologies, Inc., Macurco, Rotronic Instrument Corp.,  
Vaisala, Inc.
- 5. Liquid Leak Detection System: Kele, Raychem, Trace Tek.
  - a. Mechanical float devices attached to or inserted within the auxiliary pan are not acceptable.
  - b. Sensor shall be activated when there is at least ¼ inch of water, but no more than ½ inch of water in the auxiliary pan.
  - c. Equal to Kele Model WD-1B water detector.
    - (1) Weatherproof cast aluminum enclosure with adjustable mounting feet.
    - (2) 11-27VAC/VDC, 60 Hz, SPDT alarm contacts.
    - (3) LED indicators for power (green) and alarm (red).
    - (4) Fully adjustable detection level.

E. HUMIDITY TRANSMITTERS

- 1. Units shall be suitable for duct, wall (room) or outdoor mounting. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20 mA for percent relative humidity (%RH). A combination temperature and humidity sensor may be used for zone level monitoring. Sensors shall have the following minimum performance and application criteria:
  - a. Input Range: 0 – 100% RH
  - b. Accuracy (%RH): +/- 2% (when used for enthalpy calculation, dewpoint calculation or humidifier control) or +/- 3% (monitoring only) between 20-90%RH at 77°F, including hysteresis, linearity, and repeatability.
  - c. Sensor Operating Range: As required by application.
  - d. Long Term Stability: Less than 1% drift per year.
- 2. Acceptable Manufacturers: Units shall be Vaisala HM Series, General Eastern, Microline, or Hy-Cal HT Series.

2.5 CONTROL VALVES

- A. Valves shall be rated for a minimum of 150 percent (150%) of system operating pressure at the valve location but not less than 125 psig.
- B. 2" and Smaller: Valves shall be bronze body with screwed or flared connections.
- C. 2-1/2" and Larger: Valves shall be bronze or iron body, flanged.
- D. Flow characteristics:

1. Three-way valves shall have a linear relation of flow vs. valve position.
2. Two-way valve position vs. flow relation shall be equal percentage for water flow control.

E. Maximum pressure drop through valve:

1. Modulating water flow control: 1/2 the pressure drop through the apparatus with maximum of 10 feet of water. Two position water valves shall be line size.
2. Two-position steam control: 20 percent (20%) of inlet gauge pressure.
3. Modulating steam control: 67 percent (67%) of inlet gauge pressure but not to exceed 45 percent (45%) of inlet absolute pressure (acoustic velocity limitation).

2.6 CONTROL DAMPERS

- A. The ATC Sub-contractor shall furnish all the controlled dampers of the type and sizes indicated on the drawings for installation by the sheet metal Sub-contractor.
- B. All 2-position control dampers shall be parallel blade and sized for minimum pressure drop, at the specified duct size.
- C. All modulating dampers shall be opposed blade and sized for an effective linear air flow control characteristics within the angle of rotation and maximum pressure drops specified. Information shall be provided to the sheet metal Subcontractor for determining the proper duct reductions or baffles used.
- D. Damper frames shall not be less than 16-gauge galvanized steel, formed with corner braces for extra strength, with mounting holes for enclosed duct mounting.
- E. All damper blades shall be of not less than 16-gauge galvanized steel formed for strength and high velocity performance. Blades on all dampers must not be over 8" in width. Blades shall be secured to 1/2" diameter zinc plated axles by zinc plated bolts and nuts. All blade bearings shall be nylon or oilite. Blade side edges shall be sealed off against spring stainless steel seals. Teflon coated thrust bearings shall be provided at each end of every blade to minimize torque requirements and insure smooth operation. All blade leakage hardware shall be constructed of corrosion resistant, zinc plated steel and brass.
- F. Dampers shall be suitable for operation between -40 and 200 degrees. The control manufacturer shall submit leakage and flow characteristics plus a size schedule for all controlled dampers.
- G. All blade edges shall have inflatable seal edging that shall be rated for leakage less than 10 cubic feet per minute per square foot of damper area at a differential pressure of 4" of water when the damper is being held by a torque not to exceed 50 inert lbs. Leakage shall not exceed 1/2 of 1% of total flow.
- H. Provide permanent mark or scribe end of drive shaft to align damper with actuator in closed position.

2.7 CONTROL CABINETS

- A. Control cabinets shall be constructed of 18-gauge steel with locking hinged door. Unless otherwise specified, all controllers, electric relays, switches and other equipment furnished as part of the control system which are not required to be mounted on mechanical equipment, shall be cabinet mounted. The temperature indicators and switches shall be flush mounted on the door tagged with plastic labels. All electrical devices shall be wired to a numbered terminal strip and all devices shall be completely adjusted and checked for proper operation prior to shipment to job site. All wiring shall be numbered according to the control diagram.

2.8 SEQUENCE OF OPERATION

A. GENERAL

1. OVERVIEW

- a. All controls will be DDC, provided by Tri-M Group. The new operator's workstation will

have a graphics package that will show all equipment under control, including, but not limited to, all inputs, outputs, setpoints and modes of operations.

2. SETPOINTS

- a. All setpoints in this document are adjustable from the operator's workstations. Most are adjustable from the graphics.

3. REHEAT DISCHARGE AIR TEMPERATURE TARGET RESET

- a. The reheat discharge air temperature target will be reset based on the space temperature. During normal operation the reheat discharge air temperature target will be reset to maintain the space temperature to its heating setpoint (65°F, adjustable). In the dehumidification mode the discharge air temperature target will be reset to maintain the space temperature to its heating setpoint plus an offset (2°F, adj.). During the unoccupied mode, the heating setpoint and cooling setpoint will be reset to the building unoccupied setpoints (60°F). The reheat discharge air temperature target will be bound between 55°F and 95°F.

4. ECONOMIZER MODE

- a. The unit will be in the mechanical cooling mode if any of the following conditions are true. The outdoor air enthalpy is greater than the return air enthalpy. The outdoor air dewpoint is greater than 55°F. The outside air dry bulb temperature is above 70°F.
- b. The unit will be in the economizer cooling mode if the outdoor air enthalpy is less than the return air enthalpy. If outdoor enthalpy is less than economizer lockout setpoint, economizer mode will be off.

5. MORNING WARM-UP/COOL-DOWN MODE

- a. The BAS will provide optimized warm-up or cool-down cycle. The outdoor and space temperatures will be monitored to switch the system from unoccupied to occupied mode in sufficient time to achieve temperature settings for occupancy.

6. EQUIPMENT STARTS

- a. The system will automatically stagger the starting of all motors to prevent multiple equipment from being energized at the same time.

B. EQUIPMENT CONTROL

1. AIR HANDLING UNIT AHU-1 (EF-1 & EF-2)

a. EQUIPMENT CONTROL

(1) FAN START/STOP

- (a) The supply fan will operate continuously during the occupied mode. Upon a command to start, the outside air damper will open to schedule 1605 CFM and the associated exhaust fan (EF-1 & EF-2) will be energized. When the damper is open, the supply fan will start. The supply fan status will be determined using a current switch. If the fan proof of run is not proven within 60 seconds, an alarm will be generated at the operator's workstation.

(2) SUPPLY FAN VARIABLE SPEED DRIVE CONTROL

- (a) The supply fan will be equipped with a variable speed drive for soft-start and freeze protection. On unit startup the speed signal to the supply fan variable speed drive will be at its minimum value (30%, adjustable). After an initial time delay the speed signal to the supply fan variable speed drive will slowly increase. The speed signal to the supply fan variable speed drive will be released to its normal control sequence when the speed is at least 85% of its setpoint.

(3) PREHEAT COIL VALVE

- (a) The preheat coil valve will modulate to maintain the preheat discharge air temperature to its setpoint 50°F (adjustable). On a fall in preheat discharge air temperature below its setpoint, the preheat coil 3-way valve will modulate open to the coil to maintain the preheat discharge air temperature to its setpoint. On a rise in preheat discharge air temperature above setpoint, the reverse will occur.
- (b) The preheat coil valve will modulate regardless of the status of the supply fans.

(4) COOLING COIL VALVE

- (a) On a rise in discharge air temperature above target, the cooling coil 3-way valve will modulate open to the coil to maintain the discharge air temperature to its target. On a fall in discharge air temperature below target, the reverse will occur.

(5) REHEAT COIL VALVE

- (a) On a fall in discharge air temperature below target, the reheat coil 3-way valve will modulate open to the coil to maintain the discharge air temperature to its target. On a rise in discharge air temperature above target, the reverse will occur.

(6) DISCHARGE AIR TEMPERATURE RESET

- (a) The discharge air temperature target will be reset based on the following schedule (adjustable):

Outdoor Air Temperature (°F)	Discharge Air Temperature (°F)
65°F	55°F
10°F	62°F

(7) DEHUMIDIFICATION

- (a) If the relief humidity rises above its dehumidification setpoint (60%RH, adjustable), the unit will be placed in the dehumidification mode. The cooling coil discharge air temperature target will slowly decrease and the downstream reheat coil valve will modulate to maintain the discharge air temperature to its target. When the return humidity falls more than 2% below setpoint, the unit will return to its normal control sequence.

b. UNOCCUPIED MODE

- (1) The supply fan and associated exhaust fan (EF-24) will be de-energized, the outside air damper and cooling coil valve will be closed.

c. SAFETIES

*Note: All safety interlocks mentioned below will remain operable whether the fan in the "AUTO" or "HAND" position.*

- (1) Manual reset freezestats (set 40°F adjustable on device), will, through hard-wired interlocks, de-energize the supply air fan, close the outdoor air, and send an alarm to the operator workstation. The preheat coil valve will go to its full open position. When the freezestat is reset the speed signal to the supply fan variable speed drive will be at its minimum value (30%, adjustable). Once the preheat discharge temperature rises above 50°F (adjustable) the speed signal to the supply fan variable speed drive will slowly increase. The speed signal to the supply fan variable speed drive will be released to its normal control sequence when the speed is at least 85% of its setpoint.



- (2) Smoke detector located in the supply duct will be hardwired to shut down the supply fan, exhaust fan (EF-24) and close the outdoor air damper if products of combustion are sensed.

## 2. VAV BOX OPERATION

### a. OCCUPIED MODE

- (1) The VAV damper will maintain primary airflow between minimum (adjustable) and maximum (adjustable) setpoints in the occupied mode. On a rise in space temperature above the cooling setpoint (74°F, adjustable), the VAV airflow target will be reset from its minimum flow setpoint to its maximum flow setpoint. On a fall in space temperature below the cooling setpoint, the VAV airflow target will be reset from its maximum flow setpoint to its minimum flow setpoint with the reheat coil valve closed. The VAV damper will modulate to maintain the VAV box airflow to its target.
- (2) On a continued fall in space temperature below the heating setpoint (68°F, adjustable), the VAV airflow target will be at its minimum flow setpoint. The reheat coil valve will modulate open to maintain the reheat discharge air temperature to its target. The reheat discharge air temperature target will be reset based on the space temperature with respect to its heating setpoint. On a rise in space temperature, the reverse will occur.

### b. UNOCCUPIED MODE

- (1) During the unoccupied mode the space temperature cooling and heating targets will be reset to the building unoccupied set points (85°F. and 65°F., adjustable).
- (2) During the unoccupied mode the pushbutton override switch on the temperature sensor may be depressed which will provide occupied conditioning for one hour (adjustable).

### c. SPACE TEMPERATURE ADJUSTMENT

- (1) A slider on the space temperature sensor will allow the occupant to raise or lower the space temperature heating and cooling setpoints. The amount of temperature adjustment will be initially set to +/- 3°F and can be modified by the building operator.

## 3. AIR HANDLING UNIT AHU-1, AHU-2 & AHU-3

### a. EQUIPMENT CONTROL

#### (1) FAN START/STOP

- (a) The supply fan will operate continuously during the occupied mode. The supply fan status will be determined using a current switch. If the fan proof of run is not proven within 60 seconds, an alarm will be generated at the operator's workstation.

#### (2) PREHEAT COIL VALVE

- (a) The preheat coil valve will modulate to maintain the preheat discharge air temperature to its setpoint 50°F (adjustable). On a fall in preheat discharge air temperature below its setpoint, the preheat coil 3-way valve will modulate open to the coil to maintain the preheat discharge air temperature to its setpoint. On a rise in preheat discharge air temperature above setpoint, the reverse will occur.

- (b) The preheat coil valve will modulate regardless of the status of the supply fans.

#### (3) COOLING COIL VALVE

- (a) On a rise in discharge air temperature above target and the conditions for economizer cooling are not satisfied, the cooling coil 3-way valve will modulate open to the coil to maintain the discharge air temperature to its target. On a fall in discharge air temperature below target, the reverse will occur.

- (b) If conditions for economizer cooling are satisfied, the outside air damper is 100% open and there is a further rise in temperature above target, the outside air damper shall remain 100% open and the cooling coil valve will modulate as necessary to maintain the discharge air temperature target.

(4) REHEAT COIL VALVE

- (a) On a fall in discharge air temperature below target, the reheat coil 3-way valve will modulate open to the coil to maintain the discharge air temperature to its target. On a rise in discharge air temperature above target, the reverse will occur.

(5) DISCHARGE AIR TEMPERATURE TARGET RESET

- (a) The discharge air temperature target will be reset based on the space temperature. During normal operation, the discharge air temperature target will be reset to maintain the space temperature to its heating setpoint (68°F, adjustable) in heating mode and to its cooling setpoint (74°F, adjustable) in cooling mode. During the unoccupied mode, the heating setpoint and cooling setpoint will be reset to the building unoccupied setpoints (60/85°F). The discharge air temperature target will be bound between 55°F and 95°F.

(6) DAMPER CONTROL

- (a) When the conditions for economizer cooling are satisfied, the outdoor air damper will modulate to maintain the mixed air temperature to its target (defined as the supply air target minus 2°F). On a rise in mixed air temperature above target the outdoor air damper and relief air damper will modulate open and the return air damper will proportionately modulate closed. The reverse will occur on a fall in mixed air temperature below target. The outdoor air damper will not be allowed to go below its minimum position during economizer cooling. The outdoor air damper will remain at its minimum position whenever the unit is not in the economizer cooling mode. The outdoor air damper will be closed if the unit is not in the occupied mode.
- (b) During initial unit startup the outdoor air damper and relief air damper will be fully closed and the return air damper will be fully open. After an initial time delay the damper will control as described previously.

(7) DEHUMIDIFICATION

- (a) If the return humidity rises above its dehumidification setpoint (60%RH, adjustable), the unit will be placed in the dehumidification mode. The cooling coil discharge air temperature target will slowly decrease and the reheat coil valve will modulate to maintain the discharge air temperature to its target. When the return humidity falls more than 2% below setpoint, the unit will return to its normal control sequence.

b. UNOCCUPIED MODE

- (1) The supply fan will be de-energized, the outside air damper, relief air damper and the cooling coil valve will close. If the space temperature falls below the unoccupied heating setpoint (60°F, adjustable) the unit will be energized in full heating. If the space temperature rises above the unoccupied cooling setpoint (85°F, adjustable) the unit will be energized in full cooling. The unit will de-energize when the space temperature is at least 2°F above the unoccupied heating setpoint and is at least 2°F below the unoccupied cooling setpoint. The preheat coil valve will only be open when the outside air temperature falls below 40°F (adjustable).

c. SAFETIES

*Note: All safety interlocks mentioned below will remain operable whether the fan is in the "AUTO" or "HAND" position.*

- (1) Manual reset freezestats (set 40°F adjustable on device), will, through hard-wired interlocks, de-energize the supply air fan, close the outdoor air, relief air damper, open the return air damper, and send an alarm to the operator workstation. The preheat coil valve will go to its full open position. When the freezestat is reset the unit will restart as described previously.
- (2) Smoke detector located in the supply duct and return duct will be hardwired to shut down the supply fan and close the outdoor air damper, relief air damper and open the return air damper if products of combustion are sensed.

4. ROOFTOP ENERGY RECOVERY UNIT CONTROL (RTU-1):

- a. The unit consists of a supply fan, exhaust fan, packaged DX cooling system with hot gas reheat, hot water heating coil in preheat positions, energy recovery wheel and drive, filters, air control dampers and actuators, VFD's for each fan, and unit controls.
- b. The shall be controlled by an individual DDC Controller. The DDC Controller shall be wired to sensors which shall include, but are not limited to, a discharge air temperature sensor, exhaust air temperature sensor, return air temperature sensor, outside air temperature sensor.
- c. The BAS Contractor shall furnish required sensing and control devices to the unit manufacturer for factory installation and wiring. The equipment manufacturer shall provide the BAS Contractor with wiring diagrams for the equipment. The BAS Contractor shall then provide wiring diagrams to the equipment manufacturer detailing installation and wiring requirements for the DDC Controls.
- d. The occupied/unoccupied schedule shall correspond to the occupancy schedule as directed by Owner. Delay startup of the unit until the zone temperature has recovered from its previous setback or setup temperature during the unoccupied mode.
- e. Once activated, supply fan, exhaust fan, and energy recovery wheel shall run continuously with the outside air and exhaust air dampers open. The hot water heating section shall modulate to maintain the minimum discharge air temperature setpoint of 70 degrees F, adjustable. On a rise in discharge air temperature, the DX cooling system shall be staged to maintain a cooling discharge air temperature setpoint of 55 degrees F, adjustable. On a fall in temperature the reverse shall occur.
  - (1) Whenever the supply air duct humidity level exceeds 60%, adjustable, the unit control shall activate the modulating hot gas reheat section to reduce this condition to 50%, adjustable.
  - (2) When the unit is deactivated, the fans, heating and cooling shall be off and all dampers shall be closed.
- f. The DDC controller shall receive input from the unit's factory installed energy wheel rotation sensor for monitoring and alarm generation at the OWS.
  - (1) Unit shall continue to run in manual mode until the unit is shut down manually or at the OWS whenever the energy wheel fails.
  - (2) Whenever the outside air temperature is +/- 5°F, adjustable, of return air temperature in the unit, the energy recovery wheel shall stop.
- g. Interface with a common fire alarm input from the fire alarm system. The fire alarm contact shall be provided at the fire alarm panel by the fire alarm contractor. The status of the alarm

contact shall be communicated throughout the BAS. When the fire alarm contact indicates an alarm condition, the BAS shall de-energize the unit. When de-energized, the damper motors shall spring return the outside and exhaust air dampers closed. Provide an alarm at the OWS to indicate fire alarm status.

- h. The following items shall be displayed at the OWS:
    - (1) Discharge air temperature.
    - (2) Discharge air temperature setpoint.
    - (3) Return air temperature.
    - (4) Exhaust air temperature.
    - (5) Fire alarm system status alarm.
    - (6) Commanded status of fans.
    - (7) Supply fan operational status via a current sensor.
    - (8) Exhaust fan operational status via a current sensor.
    - (9) Energy recovery wheel commanded status and alarm.
    - (10) Diagram showing the layout of the equipment with major components and dynamic temperatures shown where temperature sensors exist in the system.
5. EXHAUST FANS
- a. EXHAUST FANS - TIME OF DAY SCHEDULE
    - (1) The exhaust fan will be energized by the BAS system based on a time of day schedule and will operate continuously during building occupied mode. The exhaust fan will be de-energized when the building is in the unoccupied mode.
    - (2) If the exhaust fan has an associated damper located directly upstream or downstream of the fan:
    - (3) When the exhaust fan is given a command to start, the corresponding isolation damper will be commanded open. When the damper opens, the fan will be energized.
  - b. EXHAUST FANS EF-3
    - (1) The exhaust fan will cycle based on space temperature. If the space temperature rises above the cooling setpoint (80°F, adjustable), the outdoor air damper will open and the exhaust fan will be energized. The outdoor air damper will close and the exhaust fan will de-energize when the space temperature is at least 5°F below the cooling setpoint. There will be a 5-minute minimum on/off time for the exhaust fan.

C. ALARMS

Description	High Limit	Low Limit	Time Delay	Type
Fan Proof of Run			60 seconds	Critical
Pump Proof of Run			60 seconds	Critical
Freezestat Trip			5 seconds	Critical
Smoke Detector Trip			5 seconds	Critical
Space Temperature			5 minutes	Critical
Boiler Alarm			5 seconds	Critical
Hot Water Temperature	200°F	120°F	5 minutes	Critical

## **PART 3 – EXECUTION**

### **3.1 INSTALLATION**

- A. Install system and materials in accordance with manufacturer's instructions and roughing-in drawings, and details and drawings. Install electrical work and use electrical products complying with requirements of these specifications. Mount controllers at convenient locations and heights.
- B. All wiring shall be properly supported and run in a neat and workmanlike manner. All wiring exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. All wiring shall be in accordance with all local and national codes. Low voltage wiring for space temperature sensors, communication bus between terminal units, etc., above accessible ceilings in finished spaces on the floors may be plenum rated cable. Wiring in all other locations shall be installed in EMT conduit. All electronic wiring shall be #18 AWG minimum THHN and shielded if required, except standard network (Ethernet, LonWorks, etc.) cabling shall be as tested and recommended in lieu of #18 gauge twisted, #22 or #24 gauge is acceptable if used as a part of an engineered structured cabling system. The control manufacturer must submit technical and application documentation demonstrating that this cabling system has been tested and approved for use by the manufacturer of both the control system and the engineered structured cabling system.
- C. Provide all sensing, control, and interlock wiring for the following:
  - System inputs and outputs
  - System communications
  - System power
  - System interlocks
  - Unit controls
- D. The Control Manufacturer shall enter all computer data into the Host computer including all graphics, control programs, initial approved parameters and settings, and English descriptors. The Control Manufacturer shall maintain diskette copies of all data file and application software for reload use in the event of a system crash or memory failure. One copy shall be delivered to the owner during training sessions, and one copy shall be archived in the Control Manufacturer's local software vault.

### **3.2 DATA CONTROL (D/C) AND GRAPHICS SUMMARY**

- A. All hardware, custom software, application software, graphics, etc., necessary to accomplish the control sequences and display the graphics specified shall be provided as part of this contract. Provide all controllers, inputs, outputs, valves, dampers, actuators and flow meters required to provide the control and graphic data described. Provide software setpoints required for display in logical groups and graphics.
- B. Each digital output shall have a software-associated monitored input. Any time the monitored input does not track its associated command output within a programmable time interval, a "command failed" alarm shall be reported.
- C. Where calculated points (such as CFM) are shown, they shall appear in their respective logical groups.
- D. Unless otherwise specified or approved prior to bidding, the primary analog input and the analog output of each DDC loop shall be resident in a single remote panel containing the DDC algorithm, and shall function independent of any primary or UC communication links. Secondary (reset type) analog inputs may be received from the primary network, but approved default values and/or procedures shall be substituted in the DDC algorithm for this secondary input if network communications fail or if the secondary input becomes erroneous or invalid.

### 3.3 ACCEPTANCE

- A. The Control Manufacturer shall completely check out, calibrate and test all connected hardware and software to ensure that the system performs in accordance with the approved specifications and sequences of operations approved.
- B. Witnessed acceptance demonstration shall display and demonstrate each type of data entry to show site specific customizing capability; demonstrate parameter changes; execute digital and analog commands; and demonstrate DDC loop stability via trend of inputs and outputs.

### 3.4 MANUALS

- A. The following manuals will be provided:
  - 1. An Operators Manual shall be provided with graphic explanations of keyboard use for all operator functions specified under Operator Training.
- B. Computerized printouts of all GPC data file including all point processing assignments, physical terminal relationships, scales and offsets, command and alarm limits, etc.
- C. A manual shall be provided including revised as-built documents of all materials required under the paragraph "SUBMITTALS" on this specification.
- D. Two Operators Manuals, and two As-Built Manuals shall be provided to the owner.

### 3.5 TRAINING

- A. All training shall be by the BMCS contractor and shall utilize operators manuals and as-built documentation.
- B. Operator training shall include three (3) four-hour sessions encompassing modifying text and graphics, sequence of operation review, selection of all displays and reports, use of all specified OWS functions, troubleshooting of sensors (determining bad sensors), and password assignment and modification. One training session shall be conducted at system completion, one shall be conducted forty five days after system completion, and one at ninety (90) days, or as requested by the Owner.

### 3.6 SERVICE GUARANTEE

- A. The control system herein specified shall be free from defects in workmanship and material under normal use and service. After completion of the installation, the control manufacturer shall regulate and adjust all thermostats, control valves, motors and other equipment provided under this contract. If within twelve (12) months from date of acceptance either for beneficial use of final acceptance, whichever is earlier, any of the equipment herein described is proven to be defective in workmanship or materials, it will be replaced or repaired free of charge. The control manufacturer shall, after acceptance, provide any service incidental to the proper performance of the control system under guarantee outlined above for the period of one year. Normal maintenance of the system or adjustments of components is not to be considered part of the guarantee. The control manufacturer will upon completion of the installation, during the warranty period, make available to the Owner, an annual service agreement covering all labor and material required to efficiently maintain the control system.

### 3.7 FINAL ADJUSTMENT

- A. After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this section.
- B. Final adjustment shall be performed by specially trained personnel in direct employ of installer of primary temperature control system.

END OF SECTION 23 0900

**SECTION 23 0450**  
**REFRIGERATION EQUIPMENT – HVAC**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.
- B. Refer to Section 230200 for HVAC General Provisions
- C. Refer to Section 230210 for HVAC Basic Materials & Methods.

**1.2 DESCRIPTION OF WORK**

- A. This Section includes labor, material, equipment and supervision to for the following:
  - 1. Ductless Split System Heat Pump Units
- B. Provide complete refrigeration system including chillers, cooling towers, underground pre-insulated pre-fabricated piping, aboveground piping and all required accessories.

**1.3 REFERENCE STANDARDS**

- A. Refer to Section 230200 for a general description of requirements applying to this section.
- B. Comply with applicable provisions of:
  - 1. International Mechanical Code
  - 2. ASME Codes for Pressure Vessels
  - 3. A.R.I. Capacity Ratings
  - 4. NFPA Pamphlets
  - 5. ASHRAE Standard 15
  - 6. ASHRAE Standard 90.1, Section 6, Table 6.8.1A thru J, minimum equipment efficiency.

**1.4 QUALITY ASSURANCE**

- A. Refer to Section 230210 for a general description of requirements applying to this Section.
- B. Whenever a variable frequency PWM drive is installed to control an AC motor, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor drive end to discharge shaft currents to ground. Recommended part: AEGIS SGRTM Bearing Protection Ring, as made by Electro Static Technology. Install in accordance with the manufacturer's written instructions.

**1.5 SUBMITTALS**

- A. Submit shop drawings and product data in accordance with Section 230200.
- B. Submit the following:
  - 1. Shop drawings and product data for all equipment in this section.
  - 2. 1/4" = 1'-0" scale layout of all equipment in Mechanical Room.

**1.6 SUBSTITUTIONS**

- A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these

requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

**1.7 WARRANTY/GUARANTEE**

- A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements. In addition, the following special guarantee applies:
  - 1. Manufacturer shall guarantee all refrigeration equipment including parts and labor, for five (5) years from start-up.

**PART 2 – PRODUCTS**

**2.1 DUCTLESS SPLIT SYSTEM HEAT PUMP UNIT**

- A. Air conditioning system shall be a ductless split system heat pump. The system shall consist of a compact ceiling-mounted packaged evaporator section and matching outdoor air-cooled condensing unit. The units shall be listed by and bear the ETL label. All wiring should be in accordance with the National Electrical Code (N.E.C.). The units shall be rated in accordance with ARI Standard 240 and bear the ARI label. A full charge of refrigerant for 100 feet of refrigerant tubing shall be provided in the condensing unit. A dry nitrogen holding charge shall be provided in the evaporator. System SEER shall meet or exceed 1992 Federal Standards.
- B. The indoor unit shall be factory assembled and wired. The casing fascia shall have a white or gray finish. The evaporator fan shall be an assembly with line flow fans direct driven by a single motor. The supply fan motor shall be multi-speed, permanent-split capacitor type with thermal overload protection and sealed, lifetime bearing. The fan shall be backward curved, centrifugal design, statically and dynamically balanced and run on permanently lubricated bearings. An adjustable guide vane shall be provided with the ability to change the air flow from horizontal to vertical. A motorized air sweep flow louver shall provide an automatic change in air flow by directing the air from side to side for uniform air distribution. Return air shall be filtered by means of an easily removable washable filter.
- C. The evaporator coil shall be nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phoscopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. The unit shall be furnished with integral condensate pump with 27" minimum lift, factory mounted and wired.
- D. The unit shall be constructed from galvanized steel that is insulated internally and externally with fire-resistant acoustic insulation.
- E. The control system shall be microprocessor based. The wall-mounted remote control enclosure shall include an LCD display providing a continuous display of operating status and condition. An keypad for setpoint/program control, unit ON/OFF, and fan speed shall be located below the display.
  - 1. The auto restart feature shall automatically restart after a power failure.
  - 2. The control shall have temperature control setpoint for cooling function with a minimum 2 deg. F differential. The temperature control setpoint range shall be 60 deg. F to 85 deg. F.
  - 3. The LCD display shall provide an ON/OFF indication, fan speed indication, operating mode indication (cooling, dehumidifying) and current day, time, temperature and humidity (if applicable) indication.
- F. Direct Expansion System Components:
  - 1. The evaporative coil shall be constructed of copper tubes and aluminum fins. The coil shall be provided with a drain pan.



2. The refrigeration system shall consist of a hermetic compressor, pressure safety switches, externally equalized expansion valve, and a refrigerant sight glass and moisture indicator.
3. Low ambient control will allow cooling to 0 deg. F outdoor temperature.
- G. Remote Air-Cooled Condenser: The condenser coil shall be constructed of copper tubes and aluminum fins, and a direct-drive centrifugal fan. No piping, brazing, dehydration or charging shall be required. Condenser electrical connection shall be by a factory wired plug. Fan shall be sized to provide full rated cooling capacity at 95 deg. F entering air. Provide wire guards on condenser coil and fan discharge.
- H. Features:
  1. Branch duct knockouts on the sides of the chassis for remote discharge of supply air.
  2. Fresh air inlet knockout for connection of ventilation air directly into the unit without the need for an inline booster fan. If the length of ductwork exceeds ten feet, provide a booster fan as scheduled on the drawings.
  3. Condensate system shall contain a float switch to automatically shut down the cooling operation if the condensate level reaches an overflow condition.
  4. Unit-mounted and wired electric backup heat with manual and automatic thermal cutout switches, for use on heat pump models.
- I. Factory installed controls shall include connections for 24-volt, hard-wired, wall-mounted thermostat, control board featuring anti-short cycle timer, 60 second post purge fan relay, on-board 30 AMP electric heat relay, and relays and connectors for condensing unit control. Provide wall-mounted solid state thermostat for field mounting and wiring to the indoor unit; the thermostat shall be capable of one-stage cooling; one-stage cooling, one-stage heating with manual changeover; one-stage cooling, two-stage heating with heat pump operation for the first stage of heat, as scheduled on the drawings.
- J. Manufacturers: Samsung, Airdale, Carrier, Daikin McQuay, Mitsubishi Electric.
  1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

### **PART 3 – EXECUTION**

#### **3.1 REFRIGERATION EQUIPMENT**

- A. All equipment to be installed in accordance with manufacturer's recommendations.

#### **3.2 DUCTLESS SPLIT SYSTEMS**

- A. Install packaged and split system units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted.
  1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements. Do not proceed with equipment start-up until wiring installation is acceptable.

#### **3.3 FIELD QUALITY CONTROL**

- A. Start-up all units in accordance with manufacturer's start-up instructions. Replace damaged or malfunctioning controls and equipment.

END OF SECTION 23 0450